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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	09/518,120
Filing Date	March 3, 2000
First Named Inventor	David L. Robinson et al.
Group Art Unit	3636
Examiner Name	Joseph F. Edell
Total Number of Pages in This Submission	
Attorney Docket Number	0739D-000074

ENCLOSURES *(check all that apply)*

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☐ Amendment / Response
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Response to Missing Parts/ Incomplete Application
  - ☐ Response to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Assignment Papers *(for an Application)*
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
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- ☐ After Allowance Communication to Group
- ☐ Appeal Communication to Board of Appeals and Interferences
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- ☐ Status Letter
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Remarks: **The Commissioner is hereby authorized to charge any additional fees that may be required under 37 CFR 1.16 or 1.17 to Deposit Account No. 08-0750. A duplicate copy of this sheet is enclosed.**

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm *or* Individual name	Harness, Dickey & Pierce, P.L.C.	Attorney Name Michael Malinzak	Reg. No. 43,770
Signature			
Date	December 22, 2003		

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EV 406 075 612 US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application No.:	09/518,120
Filing Date:	March 3, 2000
Applicants:	David L. Robinson, John F. Whalen, and Jeffery T. Bonk
Group Art Unit:	3636
Examiner:	Joseph F. Edell
Title:	**LINEAR SEAT RECLINER FOR STRUCTURAL SEAT**
Attorney Docket:	0739D-000074

Director of The United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450

APPEAL BRIEF

Sir:

Real Party in Interest

The subject application is owned by Fisher Dynamics Corporation of St. Clair Shores, Michigan.

Related Appeals and Interferences

Appellants do not know of any other appeals or interferences that will directly affect or be directly affected by or have a bearing on the Board's decision in this pending appeal.

Status of Claims

On July 7, 2003, Appellants appealed from the rejection of claims 23-38. Claims 23-38 are now pending in the application. Claims 1-22 have been cancelled without prejudice or disclaimer of the subject matter contained therein.

Status of Amendments

On November 21, 2002, Appellants filed amendments to claims 23-25 and 27-37 in response to the Examiner's rejection of August 27, 2002. The Examiner's rejection of August 27, 2002 was the first Action following Appellants' Request for Continued Examination filed on June 19, 2002. For purposes of appeal, claims 23-38, as amended in Appellants' November 21, 2002 response, stand finally rejected in an Office Action dated February 11, 2003. The claims are reproduced in Appendix A.

Summary of the Invention

Appellants' invention relates to motor vehicle seats, and more particularly, to a linear seat recliner for a motor vehicle seat.

The present invention includes a linear seat recliner for use in a motor vehicle having a seat with a seat back pivotally connected to a seat bottom. See Specification at pg. 3, lns. 22-27. The seat is operable in a plurality of use positions ranging from an upright position to a fully reclined position. See Specification at pg. 4, lns. 26-29. The linear seat recliner includes a housing adapted to be coupled to one of the seat back and the seat bottom, a latching mechanism coupled to said housing, and a recliner rod. The recliner rod includes a body having a first end and a second end. See Specification at pg. 4, lns. 23-26. The body has a substantially planar top flat diametrically opposed and parallel to a substantially planar bottom flat. See Specification at pg. 6, lns. 3-13. The top flat includes a plurality of

teeth positioned at the first end of the body. See Specification at pg. 6, lns. 2-3. The first end of the recliner rod selectively engages the latching mechanism and the second end of the recliner rod is adapted to be coupled to the other of the seat back and the seat bottom. See Specification at pg. 4, lns. 23-26.

Issues

Whether Claims 23-28 and 32-38 are unpatentable under 35 U.S.C. §103(a) over Dahlbacka, U.S. Patent No. 5,344,215, issued on September 6, 1994 (attached as Exhibit A), in view of Robinson, U.S. Patent No. 5,718,482, issued on February 17, 1998 (attached as Exhibit B).

Whether Claims 29-31 are unpatentable over Dahlbacka '215 in view of Robinson '482 as applied to Claims 23-28 and 32-38, and further in view of Griswold, et al., U.S. Patent No. 5,299,853, issued on April 5, 1994 (attached as Exhibit C).

Grouping of Claims

Claims 23-38 stand or fall together. Claims 23, 29, 32, and 36 are independent claims, respectively, claiming the invention as a linear seat recliner for use in a motor vehicle, a reclining seat assembly, a recliner rod for a linear seat recliner, and a method of forming a recliner rod for a linear seat recliner.

Argument

I. Summary of the Argument

Appellants' independent Claim 23 calls for "a recliner rod including a body having at least three pairs of substantially planar diametrically opposed and parallel flats," while independent Claim 29

similarly calls for a "recliner rod having at least three pairs of substantially planar flats." Furthermore, independent Claim 32 calls for a recliner rod having a body with "at least three pairs of diametrically opposed and substantially parallel flats," while independent Claim 36 calls for forming a recliner rod having "at least three pairs of flats including a bottom flat substantially parallel to a top flat." See Specification at pg. 6, lns. 2-13 and Figure 3. In this regard, each of Appellants' independent claims calls for a recliner rod having a least three pairs of planar flats. For example, the recliner rod (28) of the present invention could include a cross-sectional shape of a hexagon as illustrated in Figure 3. See Specification at pg. 6, lns. 1-2 and Figure 3.

In addition, Appellants' independent Claims 23 and 29 call for "a stop formed" from flats of a recliner rod. Furthermore, independent Claim 32 calls for a "stop integrally formed from a bottom flat" at a first end, while independent Claim 36 similarly calls for a method of forming a recliner rod for a linear seat recliner including the step of deforming a bottom flat at a first end of a blank to define a stop. See Specification at pg. 5, lns. 24-29 and Figure 3. In this manner, the present invention discloses a stop formed integrally with a flat of the recliner rod for selective engagement with a housing of a seat recliner. See Specification at pg. 5, lns. 24-26.

Each of Dahlbacka '215, Robinson '482, and Griswold '853 references fails to teach such a relationship. More particularly, Robinson '482 and Griswold '853 each teach a recliner rod having a generally cylindrical shape while Dahlbacka '215 teaches a recliner rod having two pairs of planar flats. The Examiner, however, maintains that adding an additional pair of planar flats to the recliner rod of Dahlbacka '215 is a mere "duplication of parts for a multiplied effect" and, thus, has no patentable significance. The Examiner adds that "it would have been well within the purview and obvious to one of ordinary skill in the art at the time the invention was made to provide another pair of parallel flats on the recliner rod such that the rod has a hexagonal cross section." In doing so, however, the Examiner

failed to establish a suggestion or motivation to modify the Dahlbacka '215 reference to include a third set of parallel flats. More particularly, the Examiner failed to support his assertion of common knowledge to one of ordinary skill in the art with objective evidence and factual findings.

Additionally, the Examiner noted that Robinson '482 shows a liner seat recliner similar to Dahlbacka '215 wherein a recliner rod has an integrally formed stop that extends orthogonally from a bottom of the recliner rod. While Robinson '482 discloses an integral stop, Robinson '482 fails to disclose an integral stop formed from a flat of a recliner rod. Furthermore, each of Dahlbacka '215 and Robinson '482 fails to teach or suggest forming an integral stop with a flat of a recliner rod as Dahlbacka '215 fails to disclose an integral stop and Robinson '482 discloses a substantially cylindrical recliner rod. In this manner, a stop formed integrally with a flat of a recliner rod is not taught or suggested by the art of record.

In this regard, Dahlbacka '215, Robinson '482, and Griswold '853, either in combination or alone, fail to teach a recliner rod having at least three pairs of planar flats or a recliner rod having a stop formed integrally with a flat of a recliner rod. In this manner, Dahlbacka '215, Robinson '482, and Griswold '853, either in combination or alone, fail to teach a recliner rod having at least two pairs of flats and an integrally formed stop. Accordingly, Appellants' invention is not taught or suggested by the art of record.

II. Background of the Invention

Most motor vehicles are equipped with seats having a seat bottom, a seat back pivotally secured to the seat bottom and a recliner mechanism for latching the seat back in a desired use position relative to the seat bottom. Generally, the recliner mechanism may be selectively actuated for adjusting the angularity of the seat back relative to the seat bottom through a range of use positions defined between

an upright position and a fully reclined position. One type of recliner mechanism, referred to as a linear seat recliner, typically includes a housing and an elongated recliner rod having a first end supported by the housing. The housing is adapted to be mounted to the seat bottom frame and the second end of the recliner rod is pivotally secured to a lever arm extension of the seat back frame. A latch assembly normally functions to latch the first end of the recliner rod to the housing. Upon release of the latch assembly, linear movement of the recliner rod relative to the housing results in angular movement of the seat back relative to the seat bottom.

Conventionally, the recliner rod is constructed from a generally cylindrical smooth rod having a circular cross section. A portion of the rod is subsequently machined to include a plurality of teeth spaced along the recliner rod. Standard manufacturing techniques such as broaching require the recliner rod to be fixed while the teeth are machined. Unfortunately, the use of a generally cylindrical recliner rod makes it difficult to properly form teeth on the rod. Specifically, the round rod has a tendency to rotate during machining making it difficult to properly align the teeth on the rod. Alternatively, the smooth cylindrical rod is commonly first machined to provide a planar segment and then broached in order to produce a suitable tooth width. Accordingly, it would be desirable to construct a linear seat recliner having a recliner rod with an economically manufactured, properly formed set of teeth.

In addition, many linear recliner mechanisms use a stop radially protruding from an end of the recliner rod in order to limit the travel of the rod in relation to the housing. While the stop is useful in limiting the travel of the seat back relative to the seat bottom, it is time consuming and costly to manufacture and attach a separate stop to a recliner rod. Therefore, it would be advantageous to design a recliner rod that is capable of providing an integral stop for minimal cost.

Lastly, recliner mechanisms may fail to function properly as a result of binding of the recliner rod with the mating components. Where a recliner rod is not well supported within the housing, it may

bend due to seat back loading. Accordingly, a guided recliner rod with an improved resistance to bending would be a welcome improvement.

III. Applicable Law

Under Patent Code §103, an invention is obvious and unpatentable if the differences between the invention and the prior art are such that "the subject matter as a whole would have been obvious at the time the invention was made" to a person skilled in that art. This standard is applied in the first instance by the Patent and Trademark Office in examining a patent application, and is also the standard applied by this Board in assessing Appellants' appeal of the Examiner's rejection.

The ultimate question of patentability is one of law, but 35 U.S.C. §103 suggests several basic factual inquiries: (1) the scope and content of the prior art are to be determined; (2) differences between the prior art and the claims at issue are to be ascertained; and (3) the level of ordinary skill in the pertinent art is to be resolved. The obviousness or nonobviousness of the subject matter is to be determined against this factual background. As indicia of obviousness or nonobviousness, secondary consideration such as commercial success, long felt but unsolved needs, and the failure of others may have relevancy. *Graham v. John Deere Co.*, 383 U.S. 1, 17, 148 USPQ 459, 467 (1966).

That said, the claimed invention must be considered as a whole. *See, e.g., Jones v. Hardy*, 727 F.2d 1524, 1529, 220 USPQ 1021, 1024 (Fed. Cir. 1984) (though the difference between the claimed invention and the prior art may seem slight, it may also have been the key to advancement of the art). Also, the references must be considered as a whole, must suggest the desirability and thus the obviousness of making the combination, and must be viewed without the benefit of the hindsight vision afforded by the claimed invention. *Hodosh v. Block Drug Co.*, 786 F.2d 1136, 1143 N.5, 229 USPQ 182, 187 N.5 (Fed. Cir. 1986).

In assessing the propriety of a combination, one must consider whether a combination of the teachings of all or any of the references would have suggested, expressly or by implication, the possibility of achieving the improvement by combining the teachings along the line of the Appellants' invention. Also, one must consider whether the claimed invention achieved more than a combination that any or all of the prior art references suggested, either expressly or by reasonable implication. *In re, Sernaker*, 217 USPQ 1, 702 Fed. 2d 989 (Fed. Cir. 1983).

Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art. "The test for an implicit showing is what the combined teachings, knowledge of one of ordinary skill in the art, and the nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art." *In re Kotzab*, 217 F.3d 1365, 1370, 55 USPQ2d 1313, 1317 (Fed. Cir. 2000).

The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). Furthermore, while a prior art device "may be capable of being modified to run the way the apparatus is claimed, there must be a suggestion or motivation in the reference to do so." 916 F.2d at 682, 16 USPQ2d at 1432.

Finally, when an Examiner notes that a feature is "obvious to one of ordinary skill in the art," the Examiner is relying on the "common knowledge" of one of ordinary skill in the art. Ordinarily, there must be some form of evidence in the record to support an assertion of common knowledge. Specifically, the general conclusions concerning what is "basic knowledge" or "common sense" to one of ordinary skill in the art without specific factual findings and some concrete evidence in the record to

support these findings will not support an obviousness rejection. *In re Lee*, 277 F.3d 1338, 1344-45, 61 USPQ2d 1430, 1434-35 (Fed.Cir. 2002) and *In re Zurko*, 258 F.3d 1379, 1386, 59 USPQ2d 1693, 1697. If notice of common knowledge is taken, the basis for such reasoning must be set forth explicitly. More particularly, the Examiner must provide specific factual findings predicated on sound technical and scientific reasoning to support his or her conclusion of common knowledge. *In re Soli*, 317 F.2d 941, 946, 37 USPQ 797, 801 (CCPA 1963).

IV. Scope and Content of the Prior Art

The Examiner has relied on three references for his rejection of Appellants' claims: (1) Dahlbacka '215, (2) Robinson '482, and (3) Griswold '853. Appellants' explain each reference next.

A. Dahlbacka '215

U.S. Patent No. 5,344,215 to Dahlbacka, copied as Exhibit A, discloses a backrest recliner for a vehicle seat having a locking mechanism operable to restrict movement of a vehicle seat back relative a seat bottom. The locking mechanism includes a recliner rod having a plurality of teeth, whereby the teeth selectively engage a plurality of teeth disposed on a housing to selectively permit rotation of the seat back relative to the seat bottom. The recliner rod is slidably received by housing and generally includes a rectangular cross section. See Dalbacka at Col. 4. lns. 51-55 and Figure 4. In this manner, the recliner rod of Dalbacka includes two pairs of opposed flats.

B. Robinson '482

U.S. Pat. No. 5,718,482 to Robinson, copied as Exhibit B, discloses a linear recliner for controllably adjusting the angular position of a seat back relative to a seat member in response to actuation by an occupant. The linear seat recliner includes a rod adapted to be operatively connected to one of the seat back or seat member and a housing pivotably connected to the other of the seat back and

the seat member. The housing is configured to receive a portion of the rod for linear movement relative thereto, whereby linear movement of the recliner rod corresponds to angular movement of the seat back relative to the seat member. The recliner rod of Robinson includes a generally cylindrical shape and is matingly received by a cylindrical bore formed in housing. See Robinson at Col. 3, lns. 41-45. In addition, the recliner rod of Robinson includes a stop for selectively restricting movement of the recliner rod relative to a housing. See Robinson at Col. 5, lns. 6-24. The stop is integrally formed with the recliner rod and extends from the generally cylindrical body of the recliner rod. See Robinson at Figures 1 and 3.

C. Griswold '853

U.S. Pat. No. 5,299,853 to Griswold, copied as Exhibit C, discloses an actuator for use with a vehicle seat. The actuator is operable to selectively restrict movement between a seat back and a seat bottom and includes a recliner rod, or shaft, for use in positioning the seat back relative the seat bottom. The recliner rod of Griswold includes a generally cylindrical shape and is matingly received by a bore formed in a housing. See Griswold at Col. 3, lns. 16-28.

V. Patentable Differences Exist Between the Prior Art and the Claims at Issue

Appellants' invention calls for a recliner rod having at least three pairs of substantially planar flats and a stop formed integrally with one of the flats. These features are unique to the present invention and provide advantages in manufacturing and strength of the recliner rod. See Specification at pg. 7, lns. 21-25. Specifically, the flats of the recliner rod help locate, guide, and hold the part during manufacturing operations to ensure proper machining and forming. Additionally, the recliner rod realizes improved bending characteristics and resistance to deformation due to the increased number of flats. See Specification at pg. 5, lns. 19-21. In this regard, the flats of the present invention are not a

mere "duplication of parts for a multiplied effect" as asserted by the Examiner, but rather, serve to improve both the manufacturability and performance characteristics of the recliner rod.

Appellants' invention calls for a stop being formed integrally with a flat of a recliner rod, whereby the stop is operable to selectively restrict movement of the recliner rod relative to a housing. See Specification at pg. 24-26. By forming the stop integrally with the recliner rod at a flat of the recliner rod, through a suitable process such as staking or swaging and the like, manufacturing costs may be reduced. See Specification at pg. 2, lns. 1-6 and pg. 5, lns. 26-29. As can be appreciated, forming such integral stop on a flat of a recliner rod is beneficial in that the flat aids in the positioning and holding of the recliner rod during forming of the recliner rod. See Specification at pg. 1, lns. 24-27 and pg. 2, lns. 1-6, and pg. 5, lns. 21-24.

As previously discussed, Dahlbacka discloses a recliner rod having two pairs of flats such that the recliner rod comprises a generally rectangular shape. See Dahlbacka at Col. 4. lns. 51-55 and Figure 4. In this regard, Appellants' assert that Dahlbacka fails to teach or suggest a recliner rod having at least three pairs of planar surfaces and that Robinson and Griswold fail to cure this deficiency of Dahlbacka. Specifically, both Robinson and Griswold each teach a recliner rod having a substantially cylindrical cross section. In this regard, a third pair of planar surfaces are not taught or suggested by either Robinson or Griswold, as both Robinson and Griswold fail to teach even one pair of planar surfaces.

In addition, the Examiner has noted that adding an additional pair of planar surfaces to the recliner rod would have been well within the purview and obvious to one of ordinary skill in the art at the time the invention was made. More particularly, the Examiner noted that "it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the linear seat surface of Dahlbacka such that the recliner rod has three pairs of parallel flats." As stated, the

Examiner has failed to support such an assertion with appropriate facts or reasoning. As previously discussed, a mere statement of common knowledge to one of ordinary skill in the art will not be sufficient to support an obviousness rejection without concurrently noting specific factual findings and concrete evidence in the record to support such an assertion.

The Examiner has stated that Robinson shows a linear set recliner similar to Dalbacka, wherein the recliner rod of Robinson includes an integrally formed stop. But the recliner rod of Robinson has a generally cylindrical shape. See Robinson at Figures 1 and 3. Thus, while Robinson fails to disclose forming an integral stop with a flat of a recliner rod, Dalbacka and Robinson together similarly fail to teach a stop formed integrally with a flat of a recliner rod.

Because Dahlbacka fails to teach or suggest a recliner rod having at least three pairs of planar surfaces or a recliner rod having a stop formed integrally with a flat of a recliner rod, and further, because both Robinson and Griswold fail to cure this deficiency on Dahlbacka, Appellants respectfully assert that the present invention is not taught or suggested by the art of record.

Summary

For the foregoing reasons, it is submitted that the Examiner's rejection of claims 23-38 was erroneous, and reversal of his decision is respectfully requested.

Respectfully submitted,

Dated: December 22, 2003 By: _____

Michael Malinzak (Reg. No. 43,770)
Matthew H. Szalach (Reg. No. 53,665)

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APPENDIX A

What is claimed is:

23. (AMENDED) A linear seat recliner for use in a motor vehicle having a seat with a seat back pivotally connected to a seat bottom, the seat being operable in a plurality of use positions ranging from an upright position to a fully reclined position, the linear seat recliner comprising:

a housing adapted to be coupled to one of the seat back and the seat bottom;

a latching mechanism coupled to said housing and actuable relative said housing between a latched position and an unlatched position; and

a recliner rod including a body having at least three pairs of substantially planar diametrically opposed and parallel flats, a top flat including a plurality of teeth positioned at said first end of said body, and a stop formed from a plurality of said flats, said plurality of teeth of said recliner rod selectively engaged with said latching mechanism.

24. (AMENDED) The linear seat recliner of Claim 23 wherein said recliner rod is adapted for sliding from a first position corresponding to the fully reclined position to a second position corresponding to the upright position, said stop engaging said housing when said recliner rod is in said first position.

25. (AMENDED) The linear seat recliner of Claim 23 wherein said stop is integrally formed in said recliner rod and orthogonally extends from a bottom flat that is diametrically opposed and parallel to said top flat.

26. (ORIGINAL) The linear seat recliner of Claim 23 wherein said body of said recliner rod has a hexagonal cross section.

27. (AMENDED) The linear seat recliner of Claim 23 wherein said housing includes a guide mechanism supporting a bottom flat of said recliner rod.

28. (AMENDED) The linear seat recliner of Claim 23 wherein said flats extend substantially between said first and second ends.

29. (AMENDED) A reclining seat assembly comprising:

a seat bottom having a side rail;

a seat back having a support rail pivotally coupled to said side rail;

a linear seat recliner including a housing secured to said support rail;

a recliner rod having a first end supported for relative linear motion within said housing and a second end having an aperture, said recliner rod having at least three pairs of substantially planar flats, a top flat having a plurality of teeth formed therein and a substantially planar bottom flat positioned parallel thereto and having a stop formed therein, said second end pivotally coupled to said side rail; and

a latching mechanism coupled to said housing and actuable relative said housing between a latched position where said latching mechanism engages said teeth to prevent relative axial movement of said recliner rod and an unlatched position where said latching mechanism allows relative axial movement of said recliner rod.

30. (AMENDED) The reclining seat assembly of Claim 29 wherein said stop radially protrudes from said bottom flat for restricting the linear motion of said recliner rod relative to said housing.

31. (AMENDED) The reclining seat assembly of Claim 30 wherein said bottom flat is diametrically opposed and parallel to said top flat.

32. (AMENDED) A recliner rod for a linear seat recliner for use in a seat having a seat back pivotally connected to a seat bottom, the seat operable in a plurality of use positions ranging from an upright position to a fully reclined position, the linear seat recliner having a housing coupled to one of the seat back and the seat bottom, the linear recliner mechanism also having a latching mechanism coupled to the housing, the recliner rod comprising:

a body having a first end and a second end, said body further having at least three pairs of diametrically opposed and substantially parallel flats;

a paddle integrally formed with said body at said second end;

a stop integrally formed from a bottom flat at said first end;

a plurality of teeth formed in a top flat, said plurality of teeth adapted to be engaged by the latching mechanism, said second end adapted to be coupled to the other of the seat back and the seat bottom.

33. (AMENDED) The recliner rod of Claim 32 wherein said top and bottom flats are diametrically opposed and parallel and extend from said first end to said second end.

34. (AMENDED) The recliner rod of Claim 32 wherein said stop is adapted to engage the housing to limit the travel of said recliner rod relative to the housing.

35. (AMENDED) The recliner rod of Claim 34 wherein said stop is adapted to engage the housing when the seat is in the fully reclined position.

36. (AMENDED) A method of forming a recliner rod for a linear seat recliner for use in a seat having a seat back pivotally connected to a seat bottom, the seat being operable in a plurality of use positions ranging from an upright position to a fully reclined position, the linear seat recliner having a housing coupled to one of the seat back and the seat bottom, the linear recliner mechanism also having a latching mechanism coupled to the housing, the method comprising the steps of:

forming a recliner rod blank having a first end, a second end, and at least three pairs of flats including a bottom flat substantially parallel to a top flat;

deforming said second end of said blank to define a paddle adapted to be coupled to the other of the seat back and the seat bottom;

deforming said bottom flat at said first end of said blank to define a stop adapted to engage the housing when the seat is in its fully reclined position; and

forming a set of teeth on said top flat, said set of teeth adapted to be selectively engageable by the latching mechanism.

37. (AMENDED) The method of Claim 36 wherein said step of forming said recliner rod blank includes extruding said blank.

38. (ORIGINAL) The method of Claim 36 wherein said step of defining top and bottom flats includes coining said body.

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US005344215A

United States Patent [19]

Dahlbacka

[11] Patent Number: 5,344,215

[45] Date of Patent: Sep. 6, 1994

[54] BACKREST RECLINER MECHANISM

[75] Inventor: Bruce B. Dahlbacka, Port Washington, Wis.

[73] Assignee: Milsco Manufacturing Company, Milwaukee, Wis.

[21] Appl. No.: 29,105

[22] Filed: Mar. 10, 1993

[51] Int. Cl.[5] B60N 2/20

[52] U.S. Cl. 297/375; 297/291; 297/300

[58] Field of Search 297/285, 300, 354.12, 297/354.13, 363-369, 372, 375, 373, 374, 291

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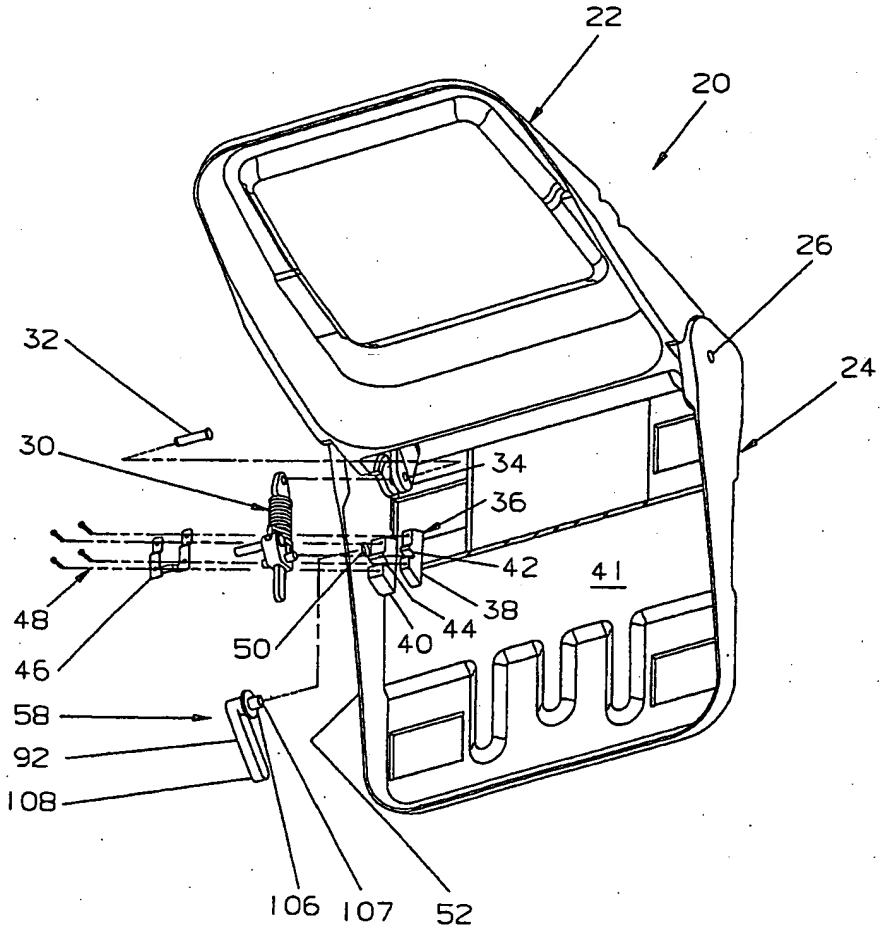
Primary Examiner—Kenneth J. Dorner
Assistant Examiner—Milton Nelson, Jr.
Attorney, Agent, or Firm—Nilles & Nilles

[57] ABSTRACT

A backrest recliner mechanism for a vehicle seat or the like includes a connector and a locking mechanism which both pivot about the same line. The backrest recliner mechanism also utilizes the energy of the backrest biasing spring to aid in the return of the locking mechanism from a disengaged to engaged position. The mechanism is actuated by a handle which minimizes the forces required to unlatch the locking mechanism. The backrest recliner mechanism is designed so as to incorporate a minimum number of parts and also to be easily and quickly assembled with minimal modification of the seat shell.

26 Claims, 10 Drawing Sheets



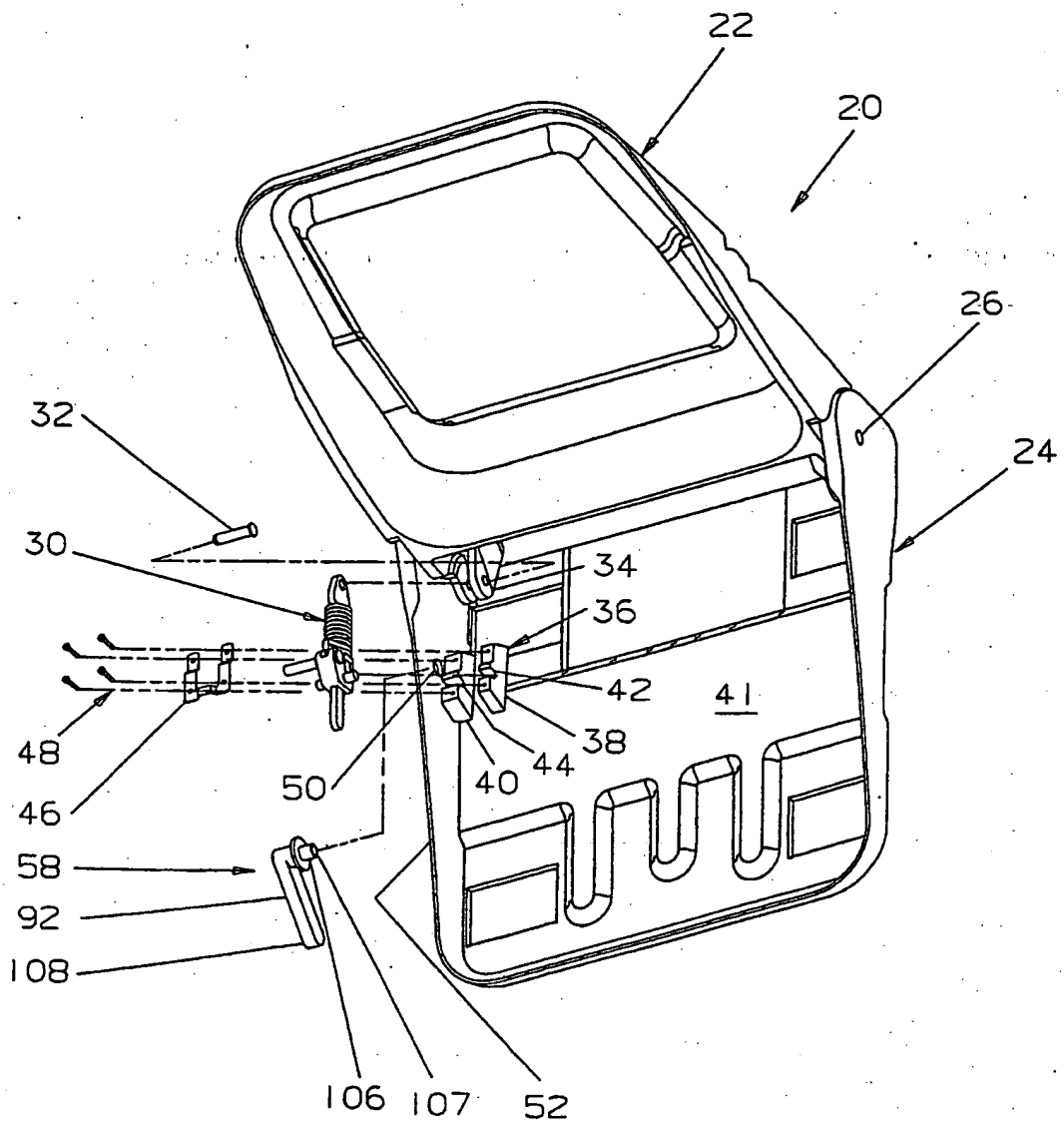


FIG. 1

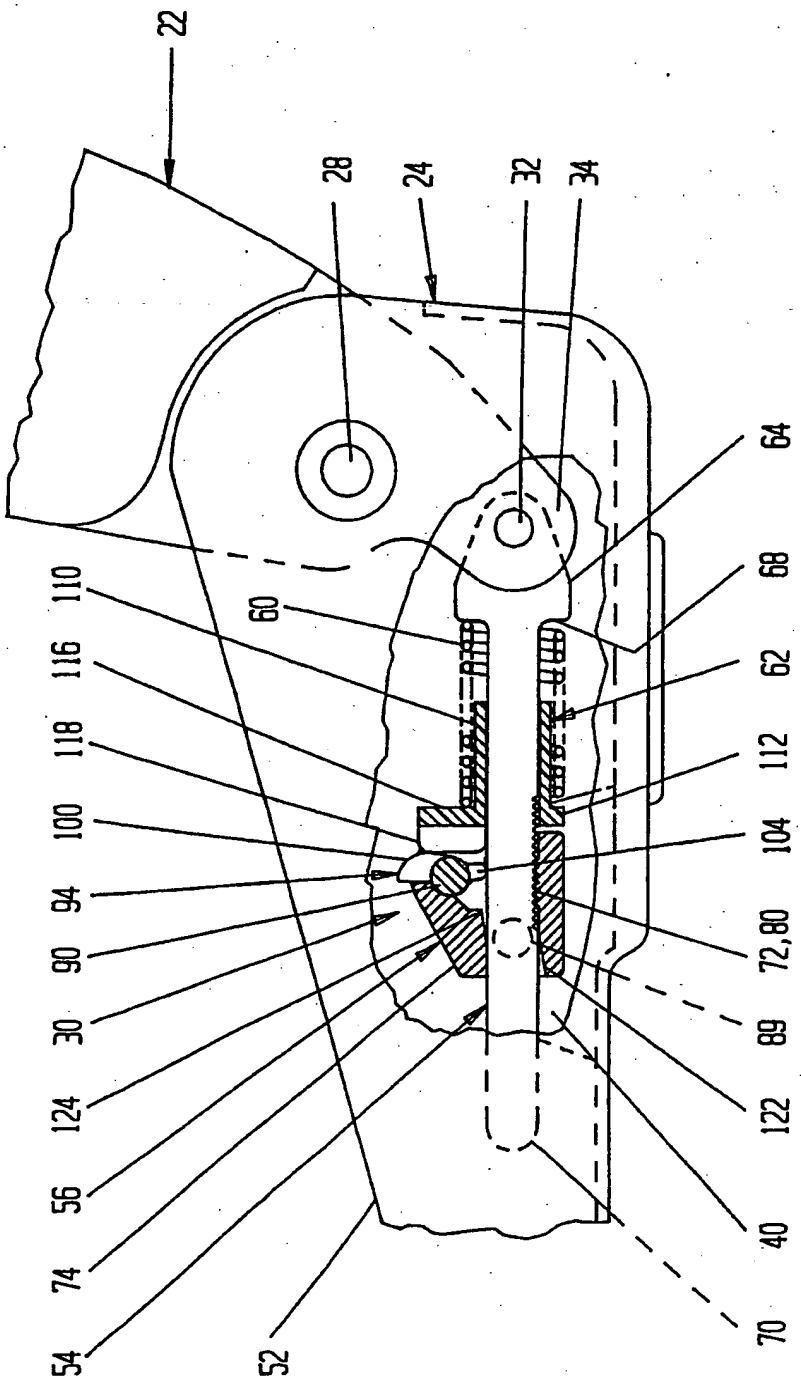

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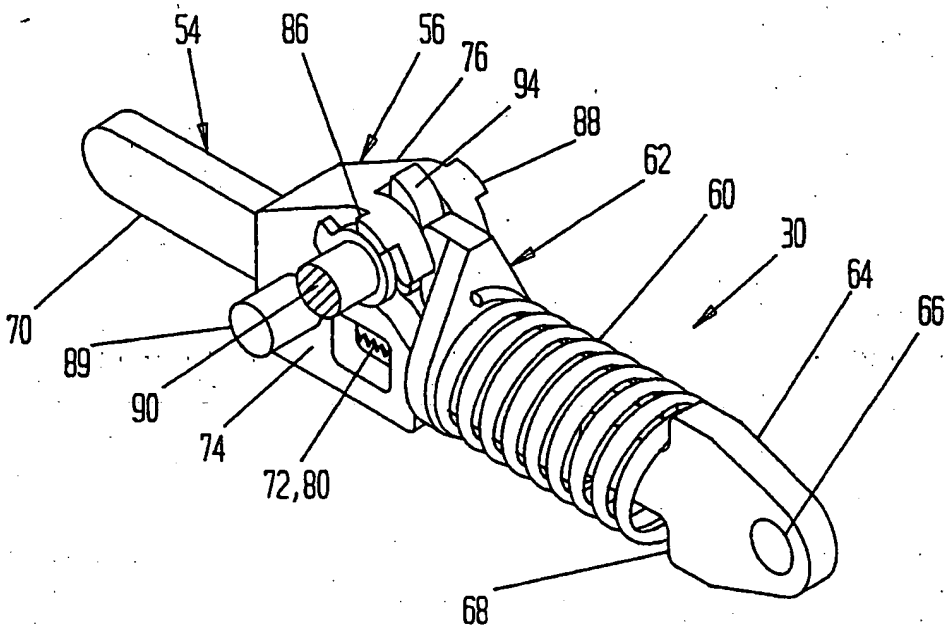
FIG. 2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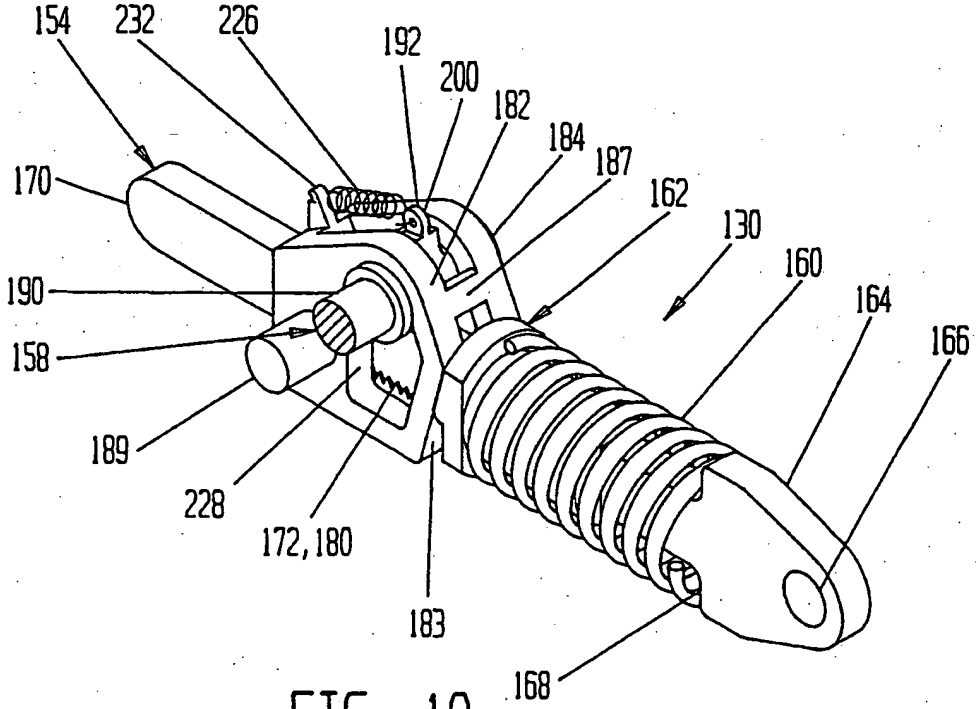
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FIG. 10

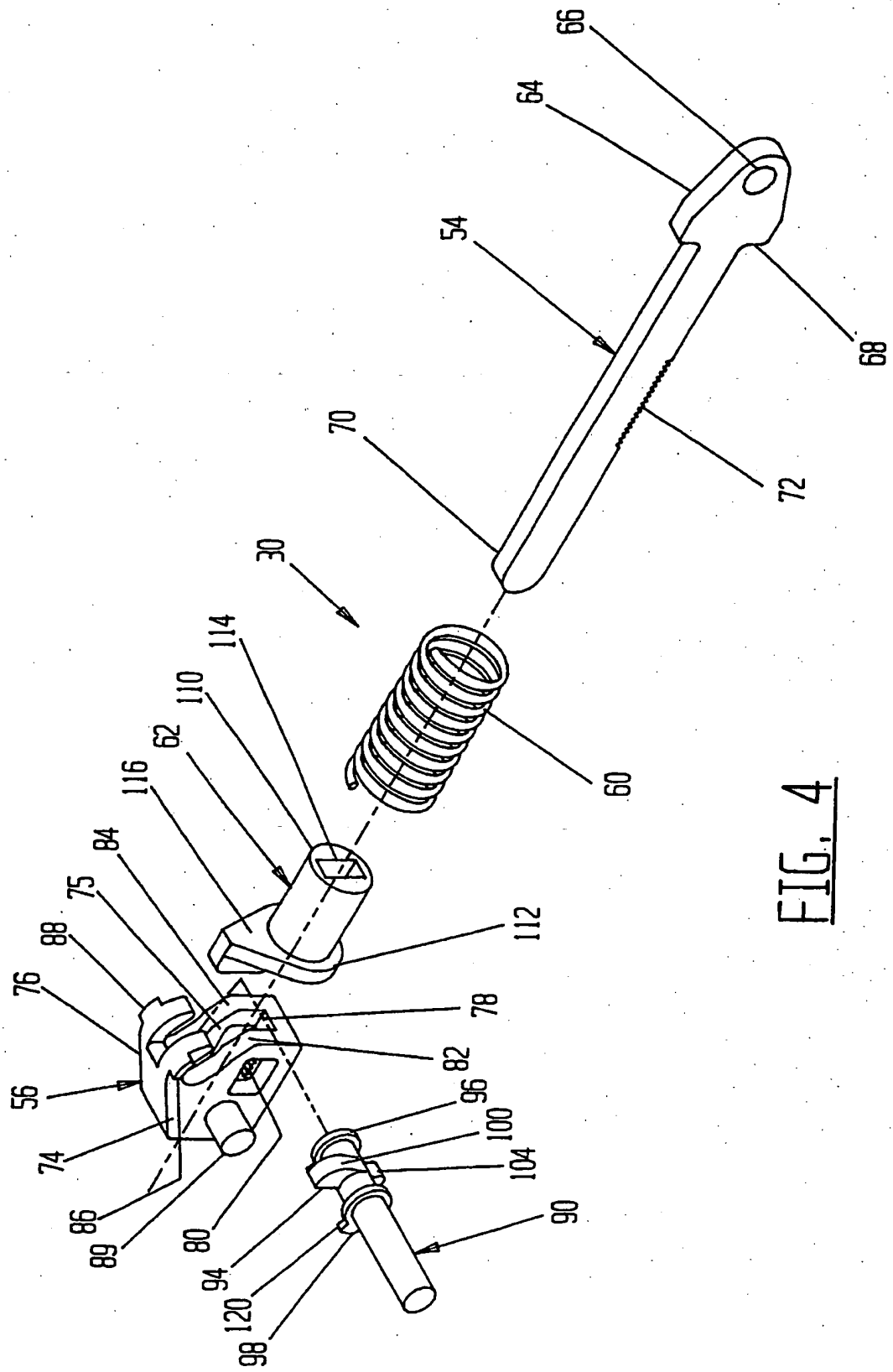
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FIG. 4

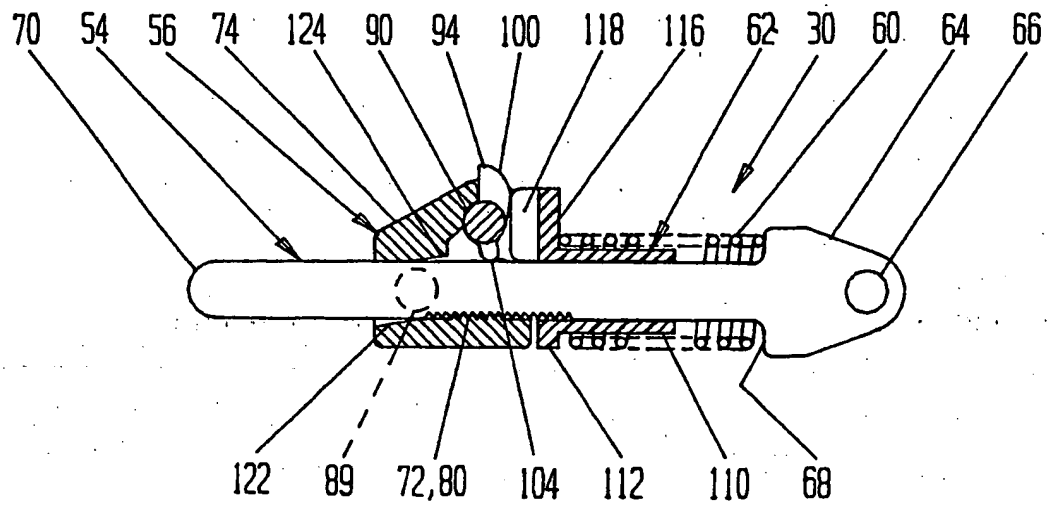
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FIG. 5

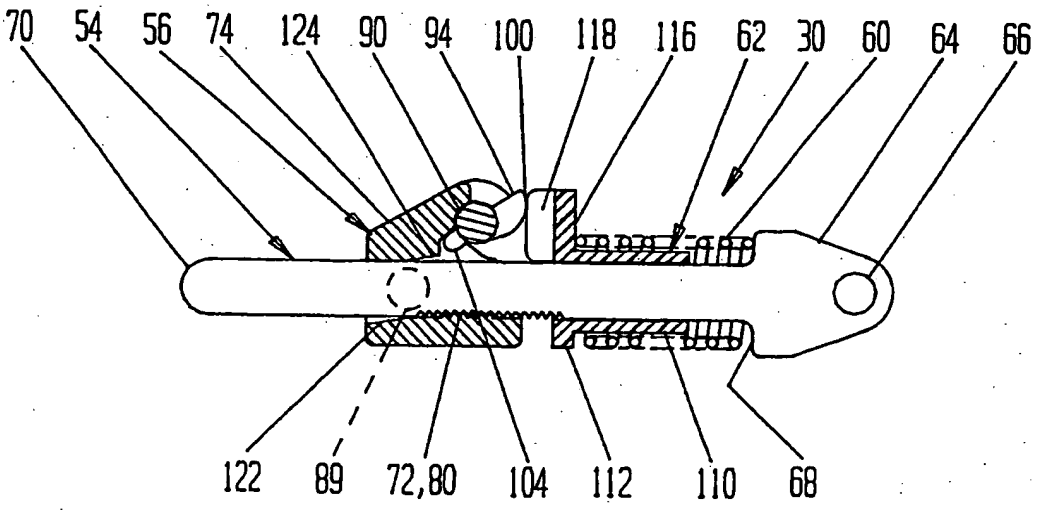
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FIG. 6

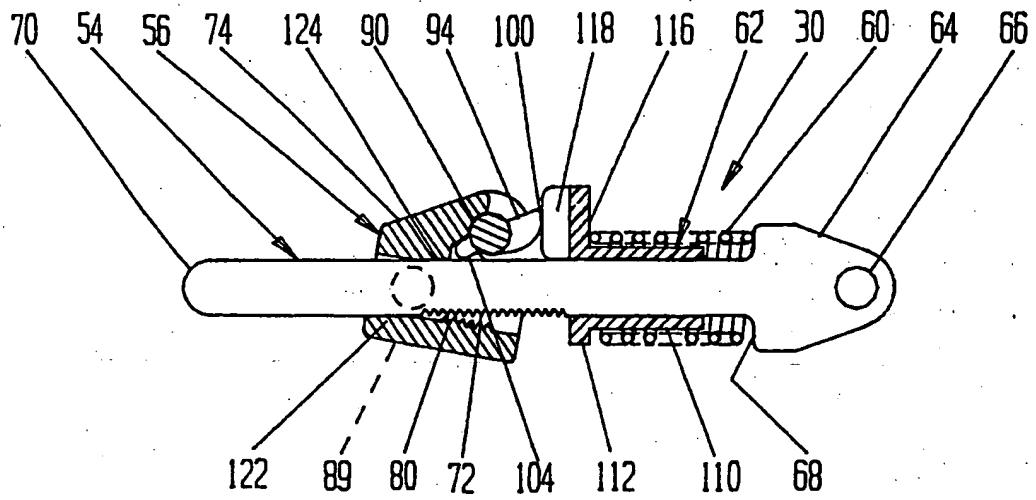
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FIG. 7

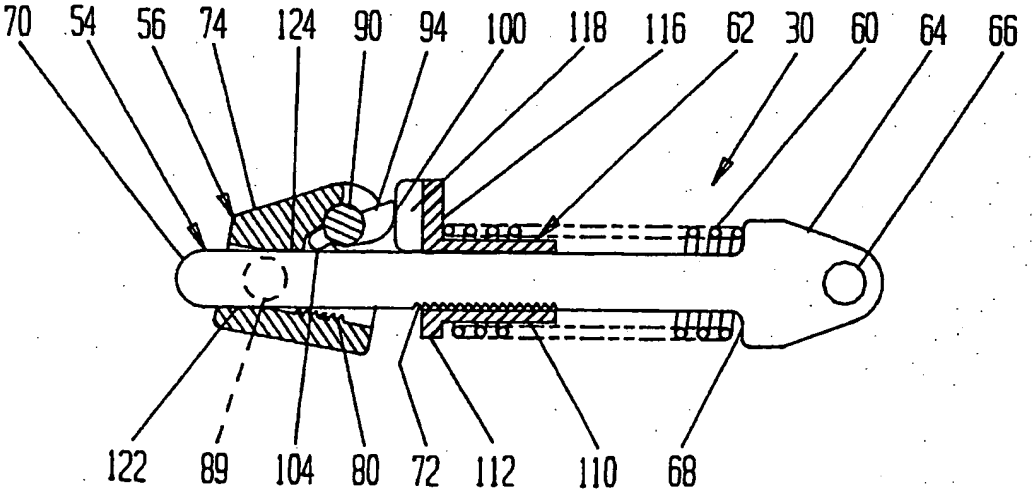
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FIG. 8

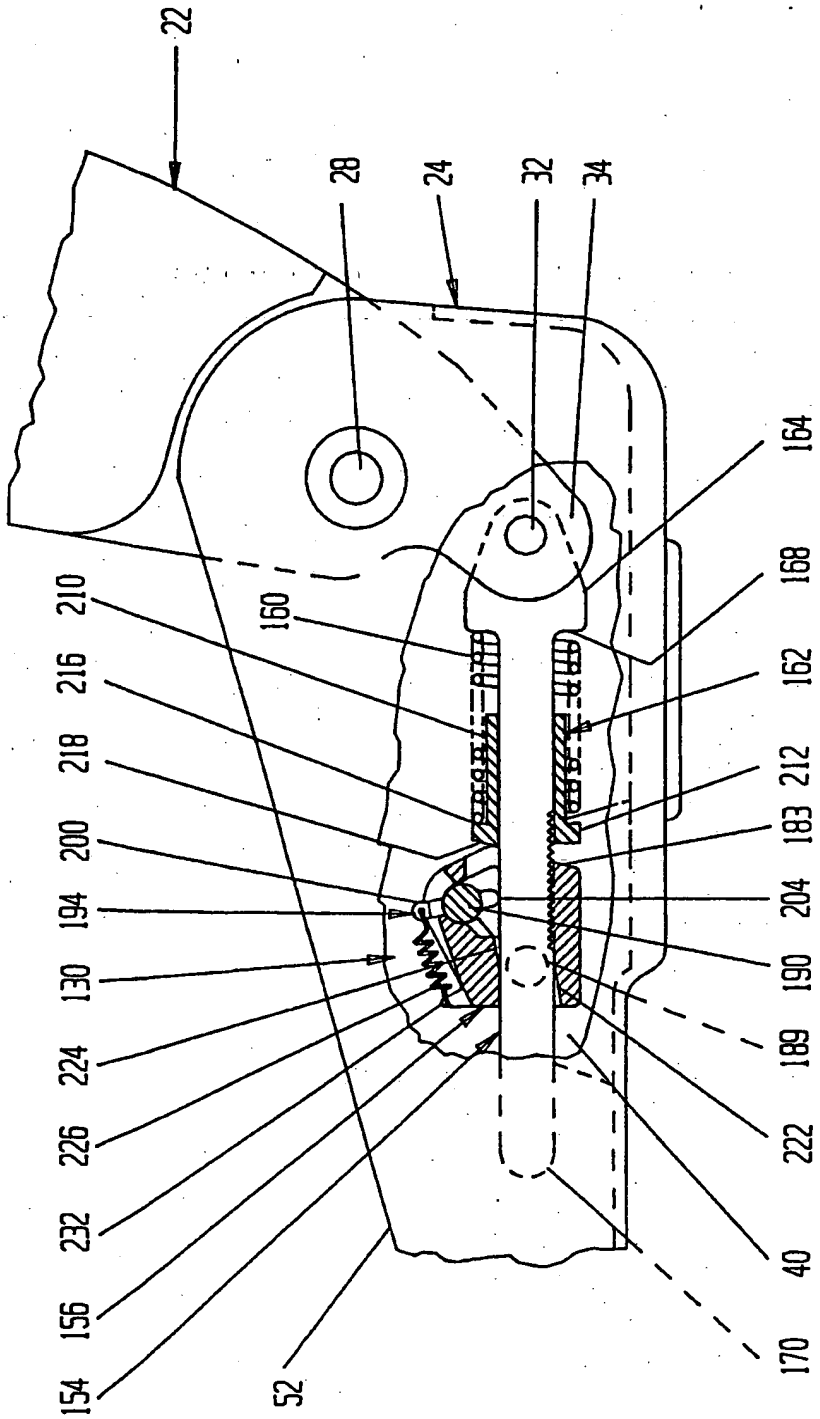
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FIG. 9

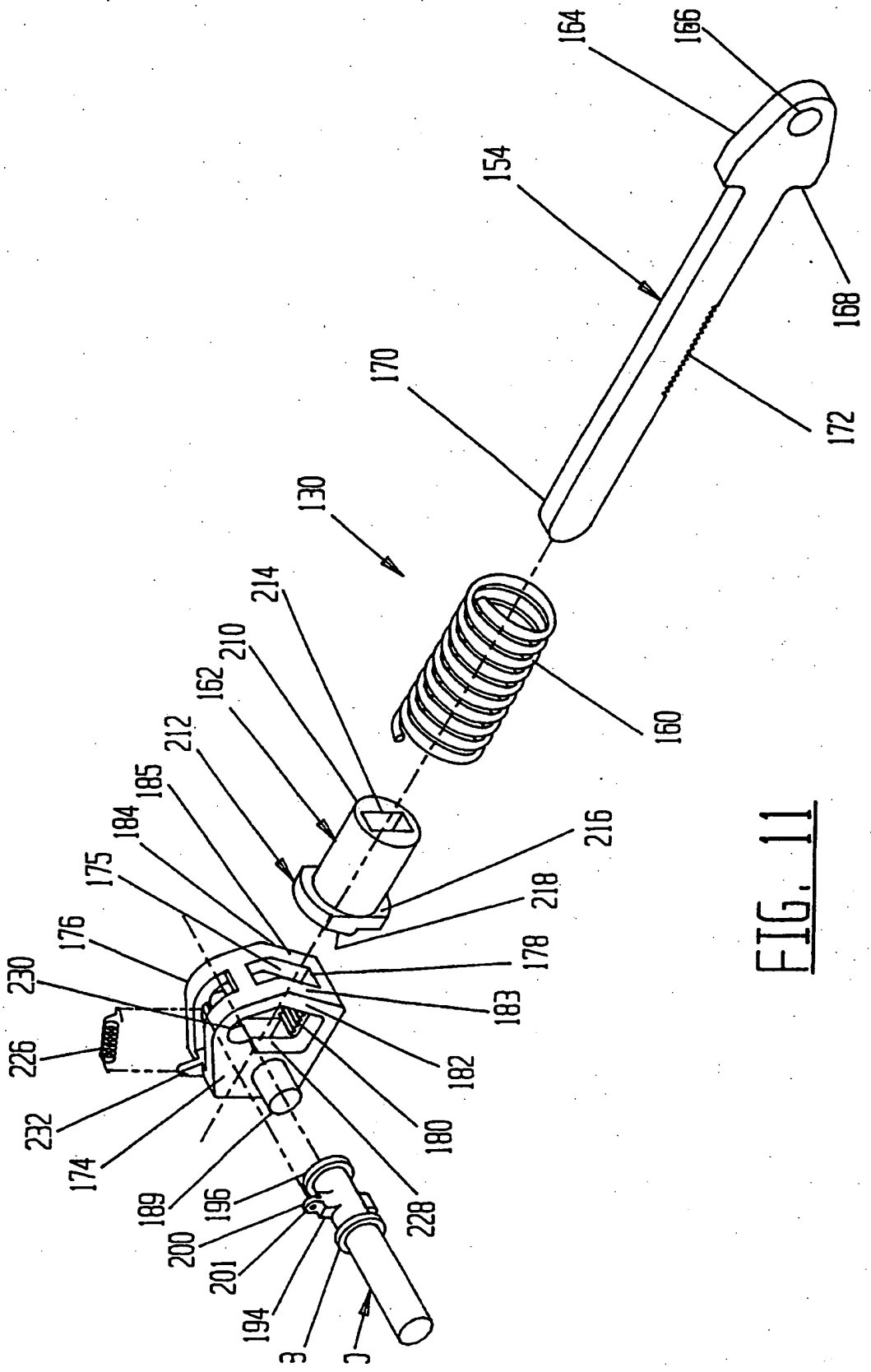
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FIG. 11

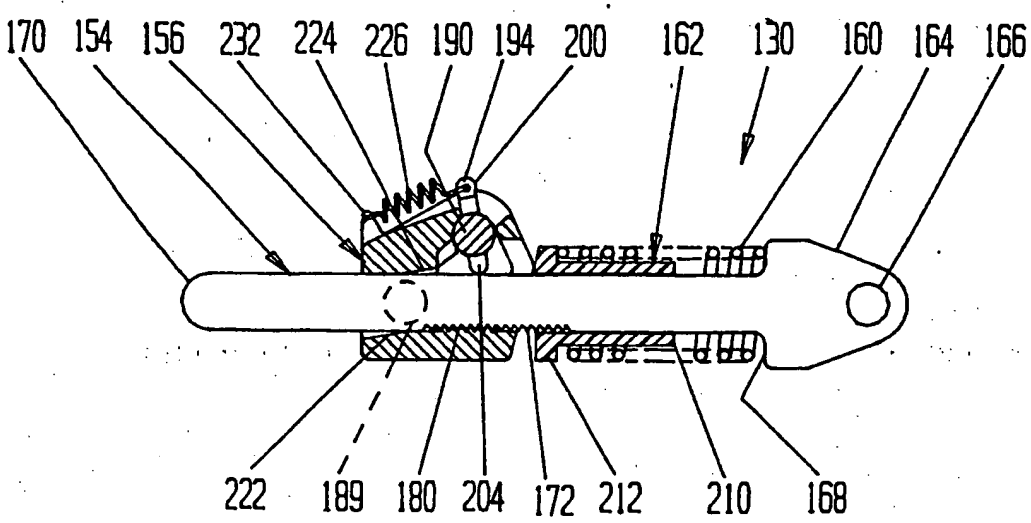
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FIG. 12

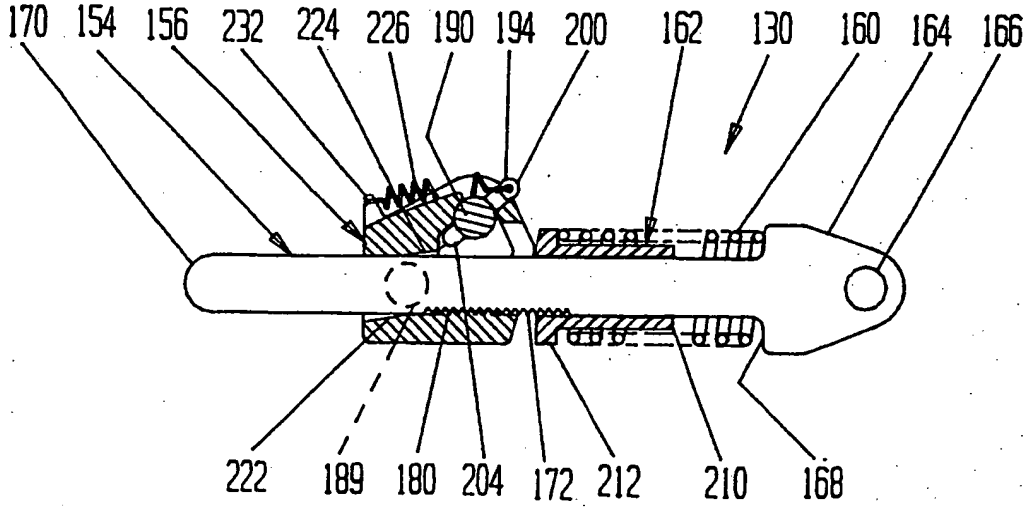
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FIG. 13

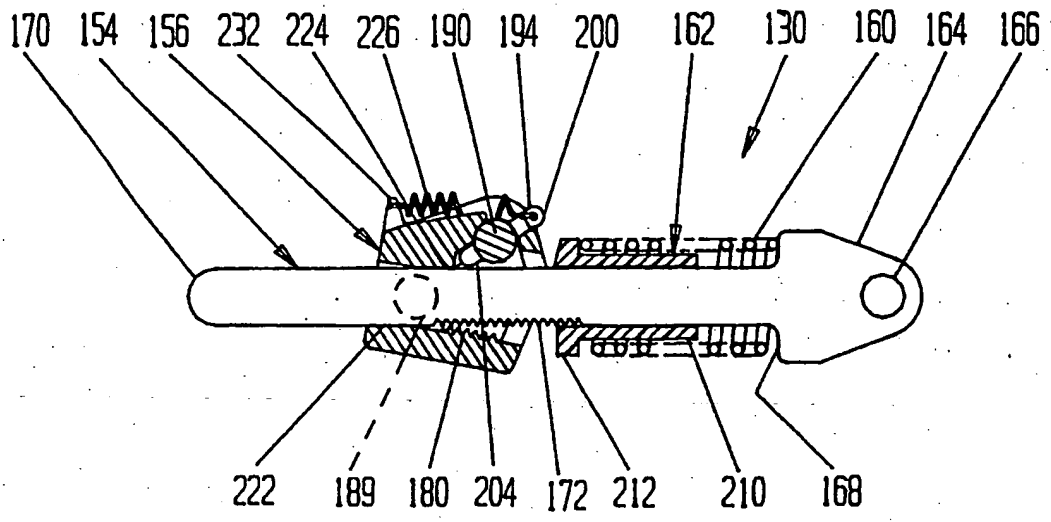
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FIG. 14

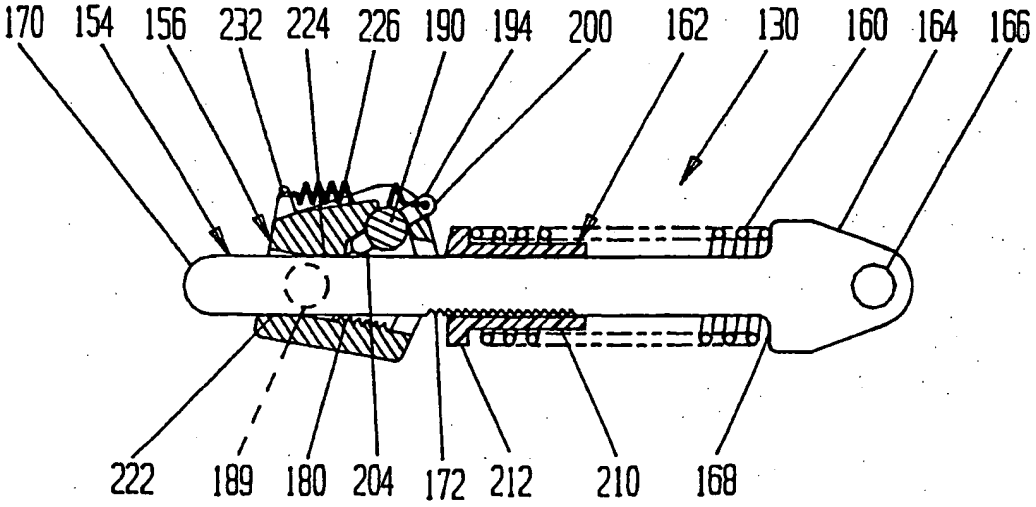
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FIG. 15

BACKREST RECLINER MECHANISM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to mechanisms for reclining the backrests of seats and, more particularly, relates to a mechanism for selectively permitting the reclining of a backrest of a vehicle seat or the like.

2. Discussion of the Related Art

Backrest recliner mechanisms are well known and are commonly used to selectively permit the occupant of a seat to adjust the angle of inclination of the backrest to best suit his or her needs. Such devices typically include a member which operatively connects the seat back to the base of the seat and which, when acted upon by the seat occupant in a designated manner, permits the backrest to recline. One such recliner mechanism is disclosed in U.S. Pat. No. 4,579,386 to Rupp et al. The recliner mechanism disclosed by Rupp et al. includes first and second elongated members each of which is connected to one of the seat base and backrest at a first end and to the other member at the second end. The first and second members are normally locked together by a handle extending therethrough at the point where the members overlap. The handle has one end which is shaped so as to lockingly engage detents formed in a slot formed in the second of the members. The backrest is permitted to recline by rotating the handle to disengage the face of the handle from the detents so that the first and second members can slide relative to one another. When the seat has been reclined to its desired position, the handle is released and is rotated back into engagement with the detents under the operation of a torsion spring.

The recliner mechanism disclosed by Rupp et al. exhibits several disadvantages. For instance, it is relatively complex and requires that the first and second members slidably engage one another over a significant length and that they be connected to one another not only by the handle but also by pins disposed on either side of the handle. Accordingly, assembly of this device requires a relatively high amount of skilled labor. Moreover, any rotation of the handle is resisted not only by the torsion spring but also by the backrest biasing spring which applies significant biasing forces on the face of the handle at all times.

OBJECTS AND SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide a backrest recliner mechanism which is easy to assemble, which has a minimum of parts, and which requires a minimum of modifications to an existing seat structure.

In accordance with this aspect of the invention, the backrest recliner mechanism includes a connector having a first end which is connectable to the backrest portion of a seat shell assembly and having a second end supported on a seat cushion portion of the seat shell; a backrest biasing spring which, in use, biases the backrest portion towards an extreme position, typically an upright position; and a locking mechanism which engages the connector between the first and second ends. The locking mechanism is movable from (1) a first position preventing movement of the connector relative to the locking mechanism to (2) a second position permitting movement of the connector relative to the locking mechanism. The locking mechanism is biased towards the first position by the backrest biasing spring.

Preferably, the connector comprises a connecting rod and the locking mechanism is provided on a housing which is pivotable from the first position to the second position, which is supported on the seat cushion portion, and which has engagement devices which form the locking mechanism and which lockingly engage mating engagement devices on the connecting rod.

Another object of the invention is to provide a backrest recliner mechanism for a backrest which, while incorporating a minimum of parts, requires minimal actuating forces.

In accordance with this aspect of the invention, a backrest recliner mechanism of the type described above is utilized, and is additionally constructed such that the housing engages a second abutment surface of a spring retainer the first surface of which engages the backrest biasing spring. The housing and second abutment surface have complimentary surfaces which are biased into engagement with one another by the backrest biasing spring such that the second abutment surface of the spring retainer urges the housing towards the first position. A locking pawl biasing spring is connected to the locking pawl and to the housing and biases the locking pawl and the integral actuating handle towards the position of rest.

If minimizing actuating forces is not considered necessary, the locking pawl itself may abut the second abutment surface of the spring retainer after a designated angle of rotation so that further rotation of the handle with respect to the housing is resisted by the backrest biasing spring.

Still another object of the invention is to provide a seat having a backrest which can be easily tilted to a reclining position and which automatically returns to an upright position.

In accordance with this aspect of the invention, a seat is provided having a seat cushion portion, a backrest portion pivotally connected thereto, and a backrest recliner mechanism of the type described above.

Other objects, features, and advantages of the present invention will become more readily apparent to those skilled in the art from the following detailed description. It should be understood, however, that the detailed description and specific examples, while indicating preferred embodiments of the present invention, are given by way of illustration and not by limitation. Many changes and modifications within the scope of the present invention may be made without departing from the spirit thereof, and the invention includes all such modifications.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and further objects of the invention will become more readily apparent as the invention is more clearly understood from the detailed description to follow, reference being made to the accompanying drawings in which like reference numerals represent like parts throughout and in which:

FIG. 1 is a perspective view of the shell of a seat incorporating a backrest recliner mechanism constructed in accordance with a first embodiment of the present invention;

FIG. 2 is a side elevation view of the backrest recliner mechanism and a portion of the seat shell of FIG. 1 with part of the seat shell cut away to reveal the backrest recliner mechanism;

FIG. 3 is a perspective view of the backrest recliner mechanism of FIGS. 1 and 2;

FIG. 4 is an exploded perspective view of the backrest recliner mechanism of FIG. 3;

FIG. 5 is a side elevation view taken along the lines 5—5 of FIG. 3;

FIGS. 6–8 are sectional side elevation views, corresponding to FIG. 5, which show the backrest recliner mechanism in different stages of operation;

FIG. 9 is a side elevation view of a seat shell incorporating a backrest recliner mechanism constructed in accordance with a second embodiment of the invention with a portion of the seat shell cut away to reveal the backrest recliner mechanism, and with the backrest recliner mechanism illustrated partially in cross section;

FIG. 10 is a perspective view of the backrest recliner mechanism illustrated in FIG. 9;

FIG. 11 is an exploded perspective view of the backrest recliner mechanism of FIGS. 9 and 10; and

FIGS. 12–15 are sectional side elevation views illustrating the backrest recliner mechanism of FIGS. 9–11 in various stages of operation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

1. Resume

A seat is provided having a backrest portion which is permitted to recline with respect to a seat base or seat cushion portion by selective operation of a backrest recliner mechanism. The backrest recliner mechanism includes a connector and a locking mechanism which both pivot about the same line. The backrest recliner mechanism also utilizes the energy of the backrest biasing spring to aid in the return of the locking mechanism from a disengaged to engaged position. The mechanism is actuated by a handle which minimizes the forces required to unlatch the locking mechanism. The backrest recliner mechanism is designed so as to incorporate a minimum number of parts and also to be easily and quickly assembled with minimal modification of the seat shell.

2. System Overview

Referring to FIGS. 1 and 2, a seat assembly 20 constructed in accordance with the preferred embodiment of the invention includes a shell having a backrest portion 22 pivotally connected to a seat base or cushion portion 24 by suitable pivot pins 26, 28 at corresponding pivot points. Seat assembly 20, though usable in virtually any application, would typically be mounted on an industrial vehicle such as a grader, tractor, etc. The shell portions 22 and 24 as illustrated are molded from a suitable plastic which is reinforced with fiberglass. However, it is to be understood that portions 22 and 24 could be constructed from any suitable material and, in their simplest form, could be constructed as simple metal or plastic frames.

Reclining of the backrest portion 22 with respect to the seat cushion portion 24 about pivot pins 26 and 28 is controlled by a backrest recliner mechanism 30 which, in the illustrated embodiment, biases the backrest portion 22 towards an upright position. Although a single backrest recliner mechanism 30 is illustrated on the right side of seat assembly 20, mechanism 30 could also be located on the left side or the center of the seat if desired. Moreover, two such mechanisms could be provided on opposite sides of the seat and controlled by a single handle connected to one another by a suitable connecting rod.

Backrest recliner mechanism 30 has a first end pivotally connected to the backrest portion 22, at a point below the pivot pin 26, by a pivot pin 32 extending through a clevis 34. Although the clevis 34 of the illustrated embodiment is located beneath pivot pin 26, it could, if desired, be located above pivot pin 26 so that the backrest portion 22 is normally biased towards a reclining position, as opposed to an upright position. The second (front) end of backrest recliner mechanism 30 is pivotally mounted on the seat cushion portion 24 by laterally spaced sections 38 and 40 of a cradle 36 formed from blocks mounted on the base 41 of the seat cushion portion 24. Each of the blocks 38 and 40 has a semi-cylindrical seat 42, 44 formed therein for receiving a respective end of the trunnion 89 of backrest recliner mechanism 30. Backrest recliner mechanism 30 is secured to the cradle 36 by a retaining clip 46 via screws 48. A hole 50 is formed in the side wall 52 of the seat cushion portion 24 to receive the handle of the backrest recliner mechanism 30.

The foregoing description defines the arrangement via which the backrest recliner mechanism 30 of the first embodiment is mounted to the seat shell 20. The same arrangement is used to mount the backrest recliner mechanism 130 of the second embodiment of the invention to seat shell 20. Each of these backrest recliner mechanisms will now be described in turn.

3. First Embodiment of the Backrest Recliner Mechanism

Referring now to FIGS. 1–8, backrest recliner mechanism 30 includes a connector which in the illustrated embodiment comprises a connecting rod 54 slidably received in a housing 56 which also receives a portion of an actuating handle 58. Connecting rod 54 supports a backrest biasing spring 60 and a spring retainer 62. A locking mechanism 80 is provided on the housing 56 and selectively engages the connecting rod 54. This locking mechanism, when engaged, prevents the seat back portion 22 from reclining and, when disengaged, permits such reclining.

Connecting rod 54 is elongated and includes a first end 64 having a transverse bore 66 formed therethrough for receiving the pin 32, and presenting a shoulder 68 which engages the rear end of spring 60. The remainder of connecting rod 54 is of a reduced cross section and extends towards the front of the seat cushion portion 24 and terminates in a second end 70. Connecting rod 54 also has a plurality of teeth 72 formed thereon which act as engagement devices for engaging the locking mechanism formed by the complementary teeth 80 formed on the housing 56. In the illustrated embodiment, connecting rod 54 is formed from a single generally rectangular steel element, but the connector formed by this rod could be constructed out of any combination of elements performing the desired function. This rod should be sufficiently long so that the distance from shoulder 68 of first end 64 to the second end 70 can accommodate maximum extension of backrest biasing spring 60 and maximum permitted rotation of backrest portion 22 about pivot pin 26, while still being supported at its front end in the housing 56. This length will vary with the maximum required extension and maximum possible compression of spring 60 and permitted rotation of backrest portion 22.

Housing 56 is preferably formed from an integral steel element having opposed side walls 74 and 76 defining a longitudinal slot 75 (FIG. 4) therebetween for passage of the connecting rod 54 and for receiving the

second abutment surface 118 of the spring retainer 62 discussed in more detail below. The side walls 74 and 76 are connected at their lower ends by a base 78 (FIG. 4) which supports the connecting rod 54 and which has engagement devices in the form of teeth 80 which are formed thereon and which act as a locking mechanism which mates with the teeth 72 of connecting rod 54. Each of the rear faces 82 and 84 of the side walls 74 and 76 is formed generally in the shape of a question mark and has lateral projections 86, 88 formed proximate the upper ends thereof. A trunnion 89 for pivotally mounting the housing 56 on the cradle 36 is formed from two cylindrical projections each extending laterally from a respective side wall 74, 76 of the housing 56.

Actuating handle 58 preferably includes a locking pawl actuator 90 and a lever 92. Locking pawl actuator 90 is rotatably mounted in the housing 56 proximate the upper end thereof and has a locking pawl 94 flanked by an inner head 96 and an outer locking ring 98 (FIG. 3) each of which is formed integral with the locking pawl actuator 90. Head 96 and locking ring 98 prevent the locking pawl actuator 90 from sliding transversely of housing 56 after the locking pawl actuator is inserted into the housing 56. Locking pawl 94 has a head 100 and a tail 104. Head 100 presents a rear face for engaging the second abutment surface 118 of the spring retainer 62 discussed in more detail below. Locking pawl actuator 90 further includes projections 120 on ring 98 and head 96 which engage projections 86 and 88 on the housing 56 upon rotation of the handle 58 in a manner discussed in more detail below.

The free end of locking pawl actuator 90 of handle 58 extends through the hole 50 formed in the side wall 52 of seat cushion portion 24 and detachably mates with the lever 92. Lever 92 is generally L-shaped and has a shorter portion presenting a washer 106 and an annular lug 107 which mate with the locking pawl actuator 90, and a second portion forming a grip 108 which can be grasped by the operator to rotate the handle 58.

Spring retainer 62 includes a generally cylindrical plastic body 110 having a head 112 formed integral with a front end thereof. The head 112 is formed with a first abutment surface 116 which engages the front end of spring 60 and an opposed second abutment surface 118 which normally extends between the hooks formed by the upper ends of the side walls 74 and 76 of the housing 56 and which is engaged by the rear face of locking pawl 94. Spring retainer 62 also has a generally rectangular longitudinal slot 114 formed therethrough which slidably receives the connecting rod 54.

Backrest biasing spring 60 is a compression spring which is relatively stiff so as to apply significant biasing forces to the backrest portion 22 of seat shell 20 so as to bias the backrest portion to an extreme position which, in the illustrated embodiment comprises an upright position. Spring 60 may be formed from steel or any other suitable material.

The backrest recliner mechanism 30 and reclining seat assembly 20 operate as follows.

During normal operation, the backrest recliner mechanism 30 assumes the position illustrated in FIG. 5 in which the slot 75 formed in housing 56 extends generally in parallel with the connecting rod 54 so that the complimentary teeth 72 and 80 formed respectively on the connecting rod 54 and housing 56 engage one another and prevent the connecting rod 54 from sliding with respect to the housing 56.

Assuming that the operator wishes to recline the backrest portion 22 of seat assembly 20, he or she releases the locking mechanism formed by teeth 80 by rotating the actuating handle 58 from the position illustrated in FIG. 5 to that illustrated in FIG. 6. During this rotation, the tail 104 of the locking pawl 94 rotates through an over-center position. This rotation is resisted through substantially its entire stroke by the backrest biasing spring 60, which is compressed via contact between the rear face of locking pawl 94 and the second abutment surface 118 of the spring retainer 62. At the end of this rotation, projections 120 of the locking ring 98 and head 96 act as stops which engage the lateral projection 86 and 88 of the front face 82, thus preventing further rotation of the handle 58 relative to the housing 56.

As illustrated in FIGS. 7 and 8, further rotation of the handle 58 results in rotation of the housing 56 with respect to the connecting rod 54 about a pivot line formed by trunnion 89 against the biasing force of backrest biasing spring 60. This relative rotation is permitted by forming the slot 75 in housing 56 such that the lower support surface of its front end 122 slopes downwardly and the upper support surface of its rear end 124 slopes upwardly. This rotation separates the teeth 72 on the connecting rod 54 from the mating teeth 80 on the housing 56, thus disengaging the locking mechanism formed by teeth 80 and permitting the connecting rod 54 to slide with respect to the housing 56. Rearward movement of the rod 54, illustrated in FIG. 8, is assisted by the biasing force of the spring 60 and permits the backrest portion 22 to pivot from a reclined position to an upright position. Conversely, forward movement of rod 54 permits the backrest portion 22 to recline further against the force of backrest biasing spring 60. The connecting rod 54 and housing 56 pivot as a unit about a pivot line formed by the trunnion 89 as the backrest portion 22 pivots so that the connecting rod 54 always extends generally orthogonally to the pivot pin 32.

When the handle 58 is released, the backrest biasing spring 60 applies a force through the second abutment surface 118 of spring retainer 62 to the rear face of locking pawl 94 to urge rotation of the housing 56 about trunnion 89 concurrently with rotation of locking pawl 94. If the connecting rod 54 is in a position in which the mating teeth 72 and 80 can mesh with one another, the front face of locking pawl 94 engages the rear surface of housing 56 as illustrated in FIG. 5 and the connecting rod 54 will be locked to the housing 56 to prevent further pivoting of the backrest portion 22. If, on the other hand, the backrest portion is reclined beyond its rearmost position or tilted forward beyond its most upright position, the connecting rod 54 is not locked to the housing 56 but instead may continue to slide with respect to the housing until it reaches the position in which the mating teeth engage one another to lock the backrest portion 22 in position.

It can thus can be seen that the backrest recliner mechanism 30 contains a minimum of components and thus can be quickly and easily assembled and mounted on the seat shell 20. Mounting and assembly are further simplified by designing the mechanism 30 such that the housing 56 and connecting rod 54 both pivot about the same trunnion 89. The construction is further simplified by using the energy of the backrest biasing spring 60 to bias the backrest recliner mechanism into a locking position.

4. Second Embodiment of the Backrest Recliner Mechanism

The backrest recliner mechanism **30** offers the advantages discussed above and works well on relatively light seats or on seats which are small enough so that a backrest biasing spring having a relatively low spring constant can be used. However, when the backrest recliner mechanism must be used on heavy seats or when space constraints require that the backrest biasing spring must have a high spring constant, the biasing forces imposed on the actuating handle **58** through the locking pawl **94** can in some cases impede the disengagement of the locking mechanism formed by teeth **80** of housing **56**.

Referring now to FIGS. **9–15**, these drawbacks can be alleviated by replacing the backrest recliner mechanism **30** with a backrest recliner mechanism **130** which is in most respects similar to the backrest recliner mechanism **30** and offers the same advantages. Those elements of the backrest recliner mechanism **130** which find corresponding elements in the backrest recliner mechanism **30** are denoted by reference numerals which are increased with respect to those representing the corresponding elements in the backrest recliner mechanism **30** by 100.

Backrest recliner mechanism **130** is connected to the same clevis **34** and cradle **36** of the seat assembly **20** of the first embodiment and is actuated by a handle having the same lever **92**. Backrest recliner mechanism **130** includes a connector (formed by a connecting rod **154**), a housing **156**, an actuating handle **158**, a backrest biasing spring **160**, a spring retainer **162**, and a locking mechanism **180** formed on housing **156**. Connecting rod **154** is identical to the connecting rod **54** of the first embodiment and includes a first end **164** having a transverse bore **166** formed therein for receiving the pin **32** and having a shoulder **168** for abutting the rear end of backrest biasing spring **160**. The connecting rod **154** extends forwardly of this first end through the housing **156** and terminates at a second end **170**. Teeth **172** are formed on the lower surface of the connecting rod **154** for mating with complimentary teeth **180** which are formed in the housing **156** and which form the locking mechanism.

Housing **156** has opposed side walls **174** and **176** which define a longitudinal slot **175** (FIG. **11**) therebetween for the passage of the connecting rod **154** and which are connected by a base **178** having the teeth **180** formed thereon. The rear faces **182** and **184** of side walls **174** and **176** differ from the corresponding faces of the housing **56** in that they present ramped surfaces **183** and **185** the shape of which complement the shape of the second abutment surface **218** of the spring retainer **162**. As will be explained in more detail below, these ramped surfaces take the place of the rear face of the locking pawl of the backrest recliner mechanism **30**. The faces **182** and **184** are connected by an upper cross bar **187** which engages the locking pawl **194** in a manner discussed in more detail below. The slot **175** has front and rear ends **222** and **224** the shapes of which are identical to the corresponding ends **122** and **124** of the housing **56** of the first embodiment.

Actuating handle **158** includes a locking pawl actuator **190** and a lever (not shown). Locking pawl actuator **190** has formed thereon an inner head **196** and an outer ring **198** which hold the actuator in place after assembly. A locking pawl **194** is formed integral with locking pawl actuator **190** and has a head **200** having an eyelet **201** (FIG. **11**) formed thereon for engaging a locking pawl biasing spring **226** in a manner discussed in more detail below. Locking pawl **194** further includes a tail **204** also discussed in more detail below.

Spring retainer **162** includes a generally cylindrical body **210** having a head **212** formed on the front end thereof and having a generally rectangular longitudinal slot **214** formed therethrough for the passage of connecting rod **154**. The rear face of head **212** forms a first abutment surface **216** (FIGS. **9** and **11**) for engaging the front end of backrest biasing spring **160**. A second abutment surface **218** (FIGS. **9** and **11**) for engaging the ramped surfaces **183** and **185** of housing **156** is formed on the front face of head **212**.

The backrest recliner mechanism **130** can be assembled and mounted in seat assembly **20** in the following manner. First, backrest biasing spring **160** is slid onto the body of connecting rod **154** so that its rear end rests on the shoulder **168** of the first end **164** thereof. Then, the spring retainer **162** is inserted onto the connecting rod **154** so that its first abutment surface **216** engages the front end of spring **160**. Meanwhile, the locking pawl actuator **190** of handle **158** is inserted into an enlarged "window" **228** formed in the housing **156** and inserted in a seat **230** defined by the upper end of window **228**. The front end of locking pawl biasing spring **226** is then connected to the eyelet **201** of locking pawl **194** and the rear end thereof is connected to a hook **232** projecting upwardly from the housing **156**. The housing **156** is then inserted onto the connecting rod **154**. Then, the backrest recliner mechanism **130** is mounted to the seat **20** in the same manner as the backrest recliner mechanism **30**.

The operation of the backrest recliner mechanism **130** will now be described with reference to FIGS. **12–15**. The backrest recliner mechanism **130** normally assumes the position illustrated in FIG. **12** with the locking mechanism being in an engaged position in which the teeth **172** on the connecting rod **154** engage the complementary teeth **180** on the housing **156** to lock the connecting rod **154** in position, and with the front face of the head **200** of locking pawl **194** resting on the housing **156**. Then, the handle **158** is rotated from the position illustrated in FIG. **12** to that illustrated in FIG. **13**. During this rotation, tail **204** of locking pawl **194** rotates through an over-center position. However, because the locking pawl **194** does not contact the spring retainer **162**, this rotation is resisted only by the relatively small biasing forces of locking pawl biasing spring **226**.

Rotation of the locking pawl actuator portion **190** of handle **158** beyond the position illustrated in FIG. **13** is prevented by engagement of the head **200** of locking pawl **194** with the cross bar **187**. Accordingly, further rotation of the actuating handle results in the pivoting of housing **156** with respect to the connecting rod **154** as illustrated in FIG. **14**, thus unlocking the locking mechanism, defined by the teeth **180**, from the teeth **172**. This rotation causes the ramped surfaces **183** and **185** to slide along the second abutment surface **218** of spring retainer **162** and to compress the backrest biasing spring **160** as illustrated in FIG. **14**. The connecting rod **154** is now free to slide with respect to housing **156** as illustrated in FIG. **15** to permit the backrest portion **22** to recline. Housing **156** and connecting rod **154** will pivot as a unit about trunnion **189** when the backrest portion **22** reclines so that the connecting rod **154** remains generally orthogonal to pin **32**. Upon releasing the handle, the backrest biasing spring **160** will force the second abutment surface **218** of the spring retainer **162** to act as a cam which engages the mating surfaces **183**, **185** of the

housing **156** to pivot the housing about the trunnion **189** back to a position in which the slot **175** is generally parallel to the connecting rod **154**. The handle **158** is then rotated back into its initial position under the biasing force of locking pawl biasing spring **226**, and the locking mechanism formed by teeth **180** engages the teeth **172** on connecting rod **154**.

It can thus be seen that by moving the cam surface from the locking pawl to the front of the housing, the forces required for release and initial rotation of the handle **156** are significantly reduced. Thus, the backrest recliner mechanism **130**, while incorporating an additional biasing spring, requires lower forces to operate.

The backrest recliner mechanisms **30** and **130** discussed above include relatively few components, are easy to assemble and to mount in the seat, and facilitate reclining of the backrest while at the same time providing secure locking of the backrest in position during normal use. Of course, the invention is not limited to the specific embodiments discussed above. Many modifications and changes which could be effected without departing from the spirit and scope of the invention will become more readily apparent from a reading of the appended claims.

I claim:

1. A seat assembly comprising:

a. a seat shell including

i. a seat cushion portion, and

ii. a backrest portion pivotally connected to said seat cushion portion; and

b. a backrest recliner mechanism including

i. a connector having a first end connected to said backrest portion and having a second end,

ii. a backrest biasing spring which biases said backrest portion towards an extreme position, and

iii. a locking mechanism which engages said connector between said first and second ends, and which is movable from

(1) a first position preventing movement of said connector relative to said locking mechanism and thus preventing said backrest portion from reclining, to

(2) a second position permitting movement of said connector relative to said locking mechanism and thus permitting said backrest portion to recline, said locking mechanism being biased towards said first position by said backrest biasing spring.

2. A seat assembly as defined in claim **1**, wherein said seat cushion portion and said backrest portion are each formed from molded plastic elements.

3. A seat assembly as defined in claim **1**, wherein said locking mechanism and said connecting rod are both pivotable with respect to said seat cushion portion about a single pivot line.

4. A seat assembly as defined in claim **1**, wherein said extreme position comprises an upright position.

5. A seat assembly as defined in claim **1**, wherein

a. said connector comprises an elongated connecting rod,

b. said backrest recliner mechanism further comprises a housing which is pivotable from said first position to said second position and which is supported on said seat cushion portion, and wherein

c. said locking mechanism includes engagement devices which are formed on said housing and which lockingly engage mating engagement devices on said connecting rod.

6. A seat assembly as defined in claim **3**, wherein said backrest recliner mechanism further comprises a handle which is rotatably mounted in said housing and which, when rotated, drives said housing to move said locking mechanism from said first position to said second position.

7. A seat assembly as defined in claim **4**, wherein said backrest recliner mechanism further comprises

a. a spring retainer which is slidably mounted on said connecting rod and which has first and second abutment surfaces which abut said backrest biasing spring and said locking mechanism, respectively,

b. a stop which is provided on said handle and which engages said housing upon a designated rotation of said handle from an initial position of rest, thus preventing further rotation of said handle relative to said housing and assuring that further rotation of said handle results in pivoting of said housing, and

c. a locking pawl which is provided on said handle.

8. A seat assembly as defined in claim **5**, wherein said locking pawl abuts said second abutment surface of said spring retainer after a designated angle of rotation so that further rotation of said handle with respect to said housing is resisted by said backrest biasing spring.

9. A seat assembly as defined in claim **5**, wherein said housing and said second abutment surface of said spring retainer have complimentary surfaces which are biased into engagement with one another by said backrest biasing spring such that said second abutment surface of said spring retainer urges said locking mechanism towards said first position.

10. A seat assembly as defined in claim **7**, wherein said backrest recliner mechanism further comprises a locking pawl biasing spring which is connected to said locking pawl and to said housing and which biases said locking pawl and said handle towards said position of rest.

11. A seat assembly comprising:

a. a seat shell including

i. a seat cushion portion, and

ii. a backrest portion pivotally connected to said seat cushion portion; and

b. a backrest recliner mechanism including

i. a connecting rod having a first end connected to said backrest portion and having a second end,

ii. a backrest biasing spring which biases said backrest portion towards an upright position, and

iii. a housing which slidably receives said connecting rod between said first and second ends, and which is movable from

(1) a first position in which teeth formed in said housing engage mating teeth on said connecting rod to prevent movement of said connecting rod relative to said housing and thus to prevent said backrest portion from reclining to

(2) a second position in which said teeth on said housing are disengaged from said teeth on said connecting rod to permit movement of said connecting rod relative to said housing and thus to permit said backrest portion to recline, said housing being biased towards said first position by said backrest biasing spring,

iv. a handle which is rotatably mounted in said housing and which, when rotated, drives said housing to pivot from said first position to said second position, said handle including

(1) a stop which is provided on said handle and which engages said housing upon a designated

rotation of said handle from an initial position of rest, thus preventing further rotation of said handle relative to said housing and assuring that further rotation of said handle results in pivoting of said housing, and

(2) a locking pawl which is provided on said handle, and

v. a spring retainer which is slidably mounted on said connecting rod and which has first and second abutment surfaces which abut said backrest biasing spring and said housing, respectively.

12. A backrest recliner mechanism for controlling the reclining of a backrest portion of a seat shell with respect to a seat cushion portion of said seat shell, said backrest recliner mechanism comprising:

a. a connector having a first end which is connectable to said backrest portion and having a second end;

b. a backrest biasing spring which, in use, biases said backrest portion towards an upright position; and

c. a locking mechanism which engages said connector between said first and second ends, and which, in use, is movable from

i. a first position preventing movement of said connector relative to said locking mechanism, to

ii. a second position permitting movement of said connector relative to said locking mechanism, said locking mechanism being biased towards said first position by said backrest biasing spring.

13. A backrest recliner mechanism as defined in claim 12, wherein said connector comprises an elongated connecting rod, said backrest recliner mechanism further comprises a housing which is pivotable from said first position to said second position and which is supported on said seat cushion portion, and wherein said locking mechanism includes engagement devices on said housing which lockingly engage mating engagement devices on said connecting rod.

14. A backrest recliner mechanism as defined in claim 13, further comprising a handle which is rotatably mounted in said housing and which, when rotated, drives said housing to pivot said locking mechanism from said first position to said second position.

15. A backrest recliner mechanism as defined in claim 14, further comprising a spring retainer which is slidably mounted on said connecting rod and which has first and second abutment surfaces which abut said backrest biasing spring and said locking mechanism, respectively.

16. A backrest recliner mechanism as defined in claim 15, further comprising

a. a stop which is provided on said handle and which engages said housing upon a designated rotation of said handle from an initial position of rest, thus preventing further rotation of said handle relative to said housing and assuring that further rotation of said handle results in pivoting of said housing, and

b. a locking pawl which is provided on said handle.

17. A backrest recliner mechanism as defined in claim 16, wherein said locking pawl abuts said second abutment surface of said spring retainer after a designated angle of rotation so that further rotation of said handle with respect to said housing is resisted by said backrest biasing spring.

18. A backrest recliner mechanism as defined in claim 16, wherein said housing and said second abutment surface of said spring retainer have complimentary surfaces which are biased into engagement with one another by said backrest biasing spring such that said second abutment surface of said spring retainer urges said housing towards said first position.

19. A backrest recliner mechanism as defined in claim 18, wherein said backrest recliner mechanism further comprises a locking pawl biasing spring which is connected to said locking pawl and to said housing and which biases said locking pawl and said handle towards said position of rest.

20. A backrest recliner mechanism for controlling the reclining of a backrest portion of a seat shell with respect to a seat cushion portion, said mechanism comprising:

a. a connecting rod having a first end which is connectable to said backrest portion and having a second end;

b. a backrest biasing spring which, in use, biases said backrest portion towards an upright position;

c. a housing which includes a locking mechanism which engages said connecting rod between said first and second ends, and which is pivotable from (1) a first position preventing movement of said connecting rod relative to said housing, to (2) a second position permitting movement of said connecting rod relative to said housing; and

d. a spring retainer which is slidably mounted on said connecting rod and which has first and second abutment surfaces which abut said backrest biasing spring and said locking mechanism, respectively, said housing and said second abutment surface of said spring retainer having complimentary surfaces which are biased into engagement with one another by said backrest biasing spring such that said second abutment surface of said spring retainer urges said housing towards said first position.

21. A backrest recliner mechanism as defined in claim 20, further comprising

a. a handle having a locking pawl provided thereon, said handle being rotatable with respect to said housing from a position of rest to a further position in which further rotation of said handle relative to said housing is prevented, and which, when rotated beyond said further position, pivots said housing from said first position to said second position, and

b. a locking pawl biasing spring which is connected to said locking pawl and to said housing and which biases said handle towards said position of rest.

22. A method of reclining the backrest of a seat assembly with respect to a seat thereof, said backrest being pivotally mounted to said seat and being coupled to said seat by a backrest recliner mechanism including a connector having a first end connected to said backrest and having a second end, said backrest being biased towards an extreme position by a backrest biasing spring, said method comprising the steps of:

a. disengaging a locking mechanism, which, when engaged, prevents movement of said connector relative to said seat and thus prevents said backrest from reclining;

b. moving said locking mechanism against the biasing force of said backrest biasing spring from a first position to a second position permitting movement of said connector relative to said seat and thus permitting said backrest to recline;

c. pivoting said backrest about said seat, thereby reclining said backrest; and

d. releasing said locking mechanism and permitting said locking mechanism to move back into said first

position under the biasing force of said backrest biasing spring.

23. A method as defined in claim 22, wherein

a. said locking mechanism comprises teeth on a housing which engage complementary teeth on said connector, said housing supporting said connector,

b. said step a. comprises disengaging said teeth,

c. said step b. comprises pivoting said housing with respect to said connector, and

d. said step c. comprises pivoting said housing and said connector about a common pivot line while said backrest pivots.

24. A method as defined in claim 22, wherein said backrest biasing spring biases said seat back towards an upright position.

25. A seat assembly comprising:

a. a seat shell including

i. a seat cushion portion, and

ii. a backrest portion pivotally connected to said seat cushion portion; and

b. a backrest recliner mechanism including

i. a connecting rod having a first end connected to said backrest portion and having a second end,

ii. a backrest biasing spring which biases said backrest portion towards an extreme position, and

iii. a locking mechanism which engages said connecting rod between said first and second ends, and which is movable from

(1) a first position preventing movement of said connecting rod relative to said locking mechanism and thus preventing said backrest portion from reclining, to

(2) a second position permitting movement of said connecting rod relative to said locking mechanism and thus permitting said backrest portion to recline, wherein said locking mechanism is pivotable with respect to said connecting rod about a pivot line and said connecting rod is pivotable with respect to said seat cushion portion about said pivot line, said locking mechanism being biased towards said first position by said backrest biasing spring.

26. A seat assembly as defined in claim 10, wherein said extreme position comprises an upright position.

* * * * *

US005718482A

United States Patent [19]

Robinson

[11] Patent Number: 5,718,482

[45] Date of Patent: Feb. 17, 1998

[54] SIMPLIFIED LINEAR RECLINER

[75] Inventor: David L. Robinson, Sterling Heights, Mich.

[73] Assignee: Fisher Dynamics Corporation, St. Clair Shores, Mich.

[21] Appl. No.: 596,988

[22] Filed: Feb. 5, 1996

[51] Int. Cl.[6] B60N 2/02

[52] U.S. Cl. 297/367; 297/362.12

[58] Field of Search 297/361.1, 362.12, 297/366, 367, 463.1

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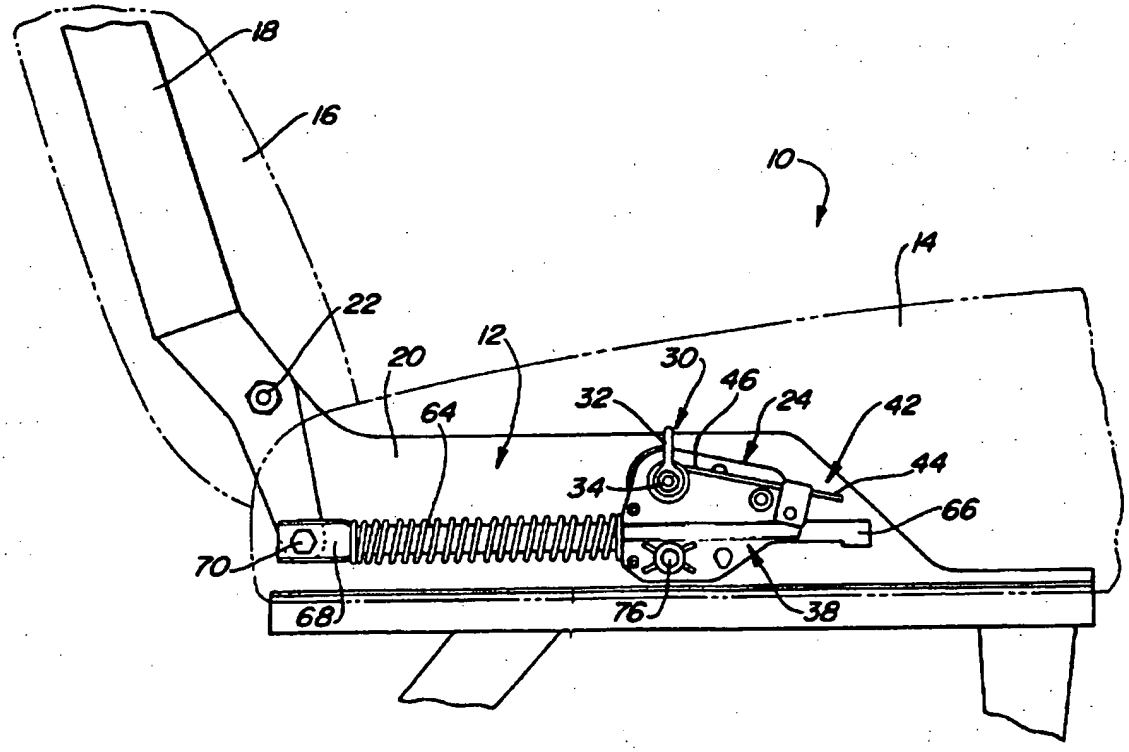
Primary Examiner—Milton Nelson, Jr.

Attorney, Agent, or Firm—Harness, Dickey & Pierce, P.L.C.

[57] ABSTRACT

A linear recliner is described for controllably adjusting the angular position of a seatback relative to a seat member in response to actuation by a seat occupant. The linear seat recliner includes a rod adapted to be operatively connected to one of the seatback and the seat member and a housing pivotably connected to the other of the seatback and the seat member. The housing is configured to receive a portion of the rod for linear movement relative thereto whereby linear movement of the recliner rod corresponds to angular movement of the seatback relative to the seat member. The linear seat recliner further includes a cam plate coupled for rotation with an actuator shaft and which is adapted to engage a toothed pawl so as to move the pawl to and from engagement with the toothed portion of the recliner rod, thereby establishing locked and released modes for the linear seat recliner. In one embodiment, substantially similar slave and master latch mechanisms are provided with the master latch mechanism connected to a release mechanism operable to shift both latch mechanisms from their latched conditions.

15 Claims, 5 Drawing Sheets



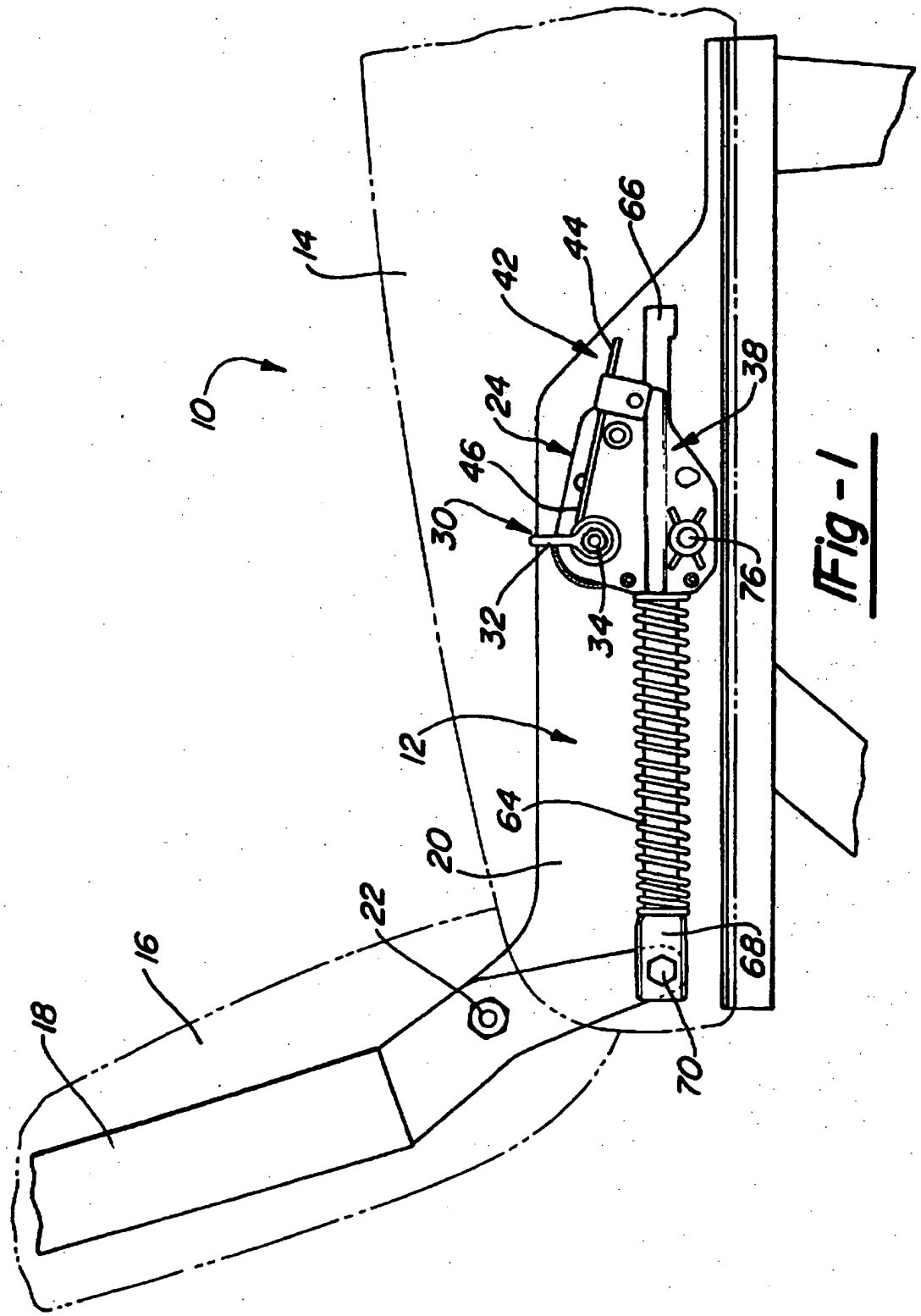
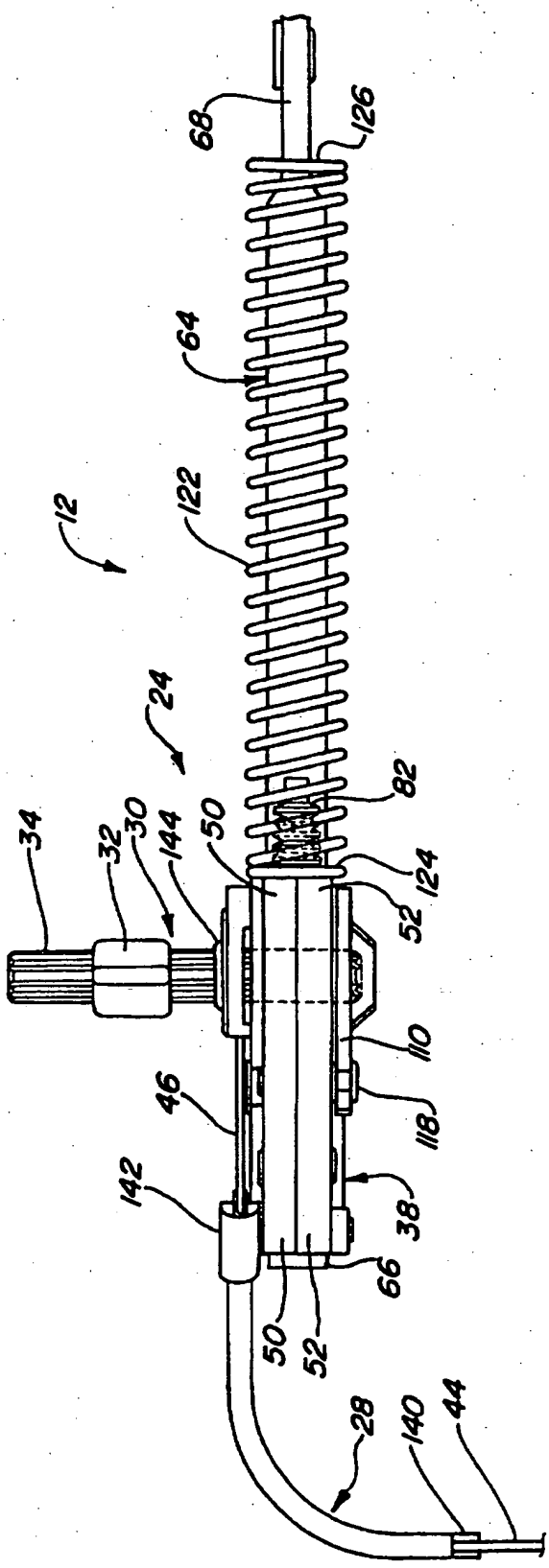


Fig - 1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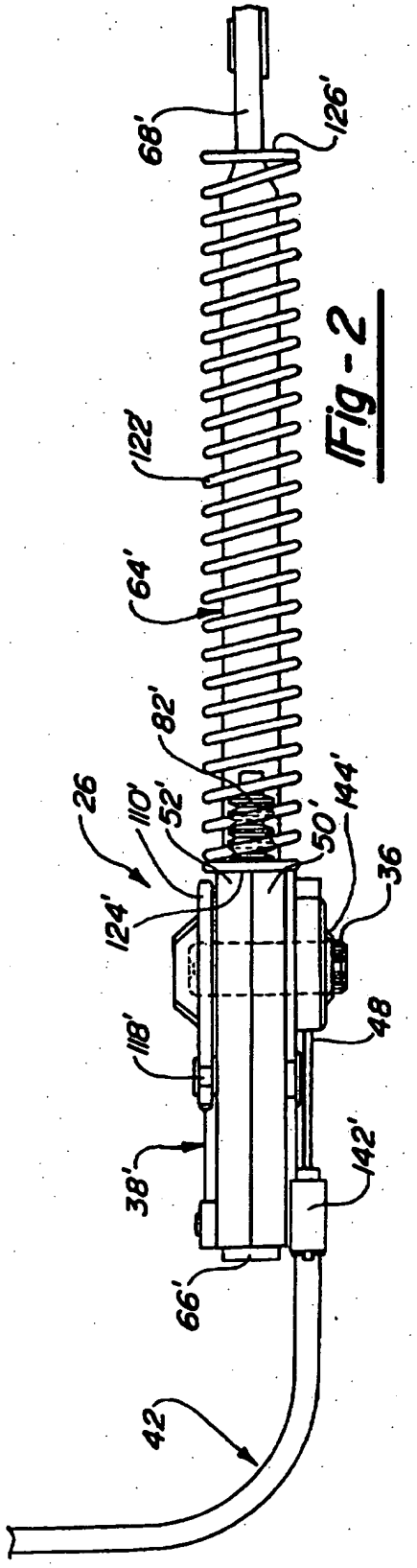
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Fig - 2

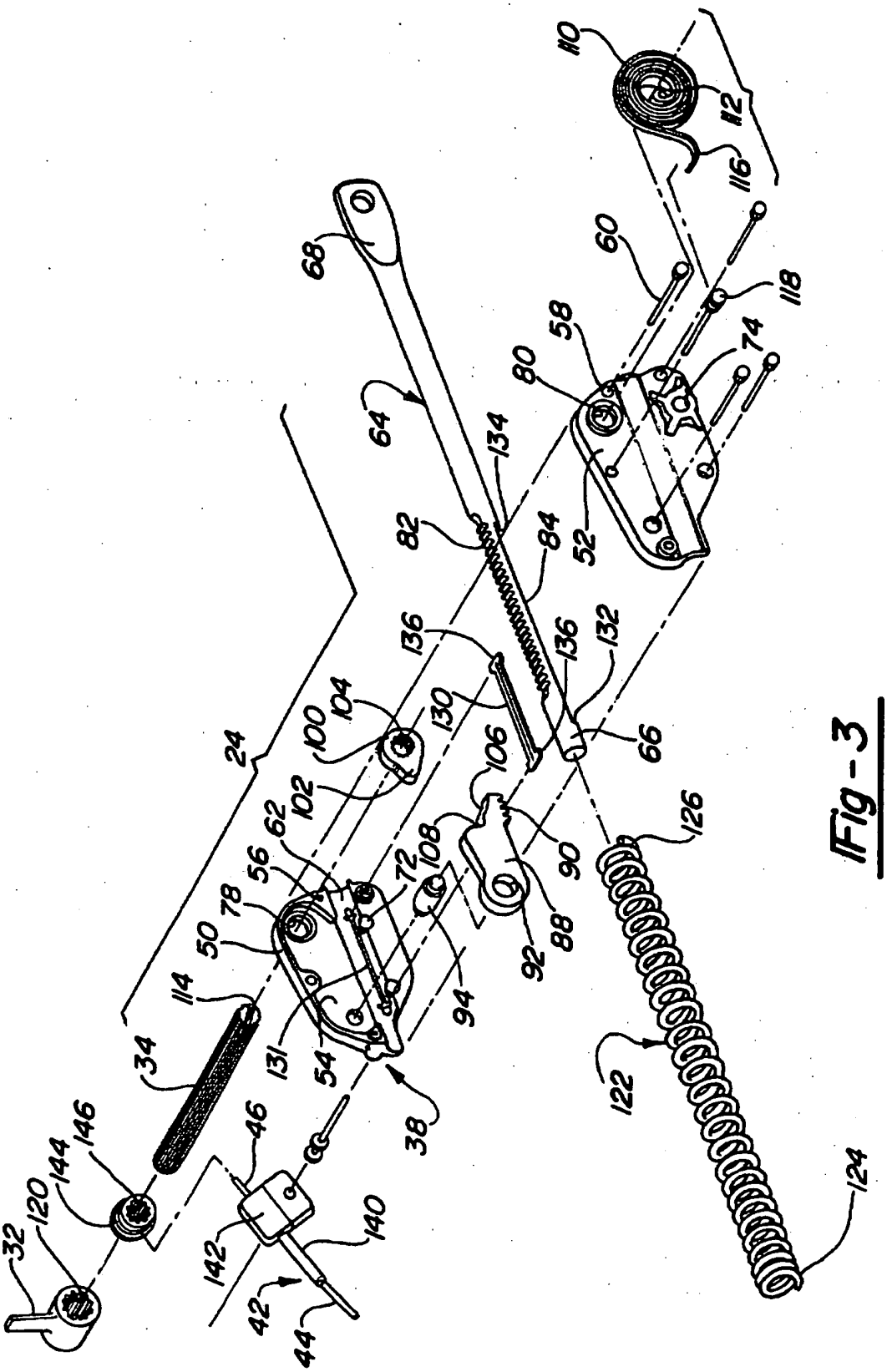
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Fig - 3

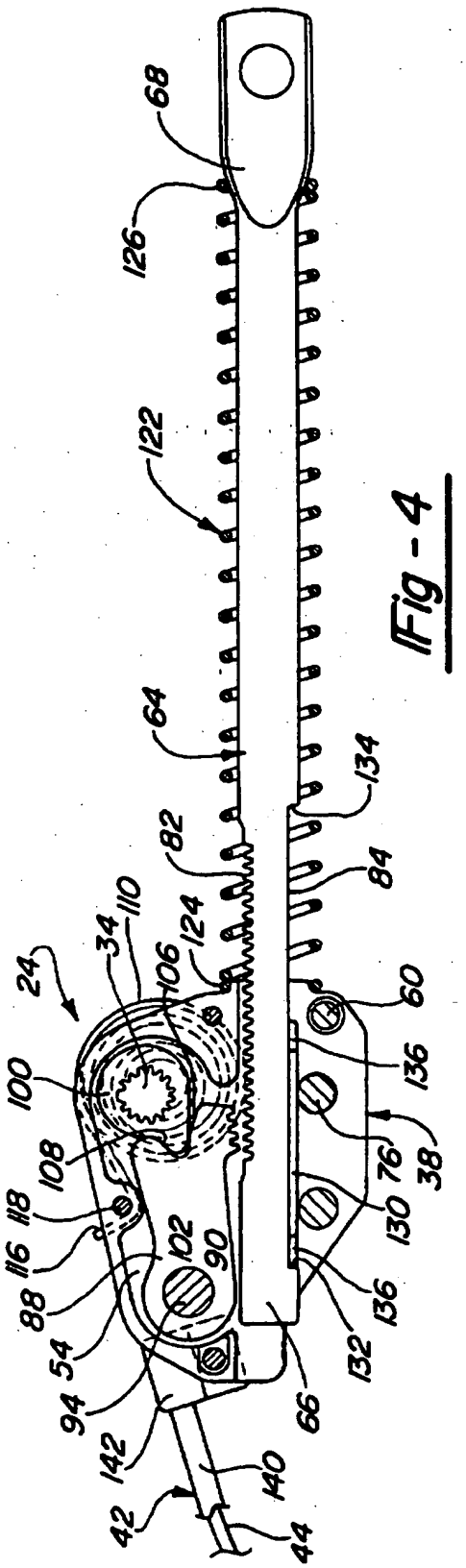
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Fig - 4

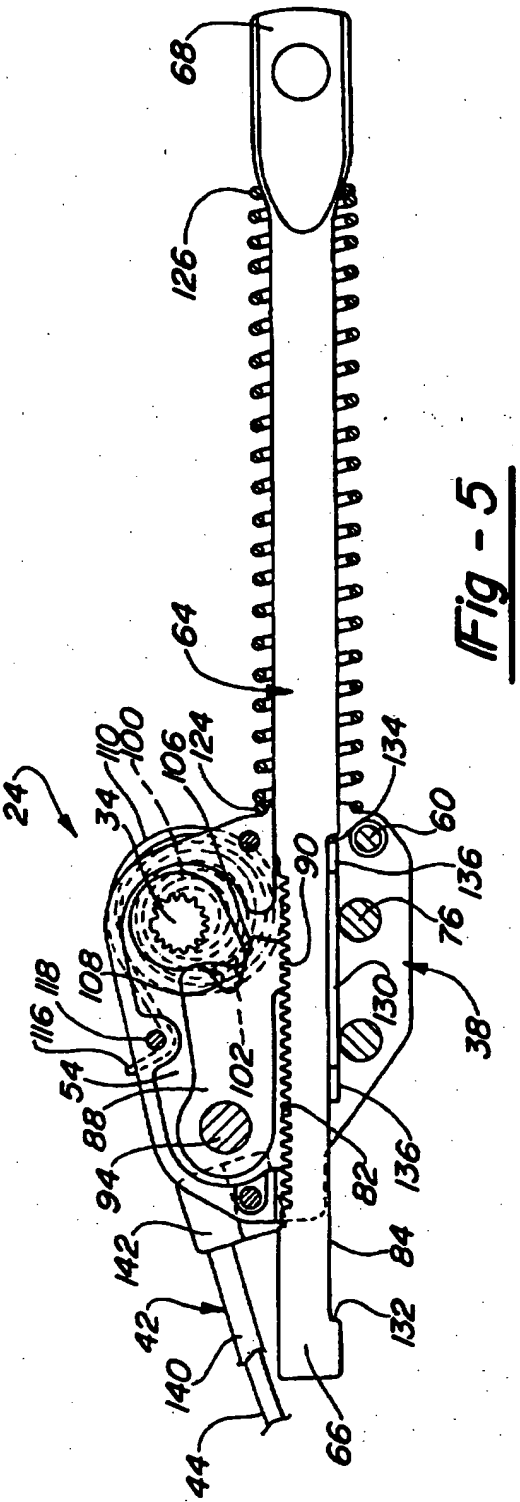
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Fig - 5

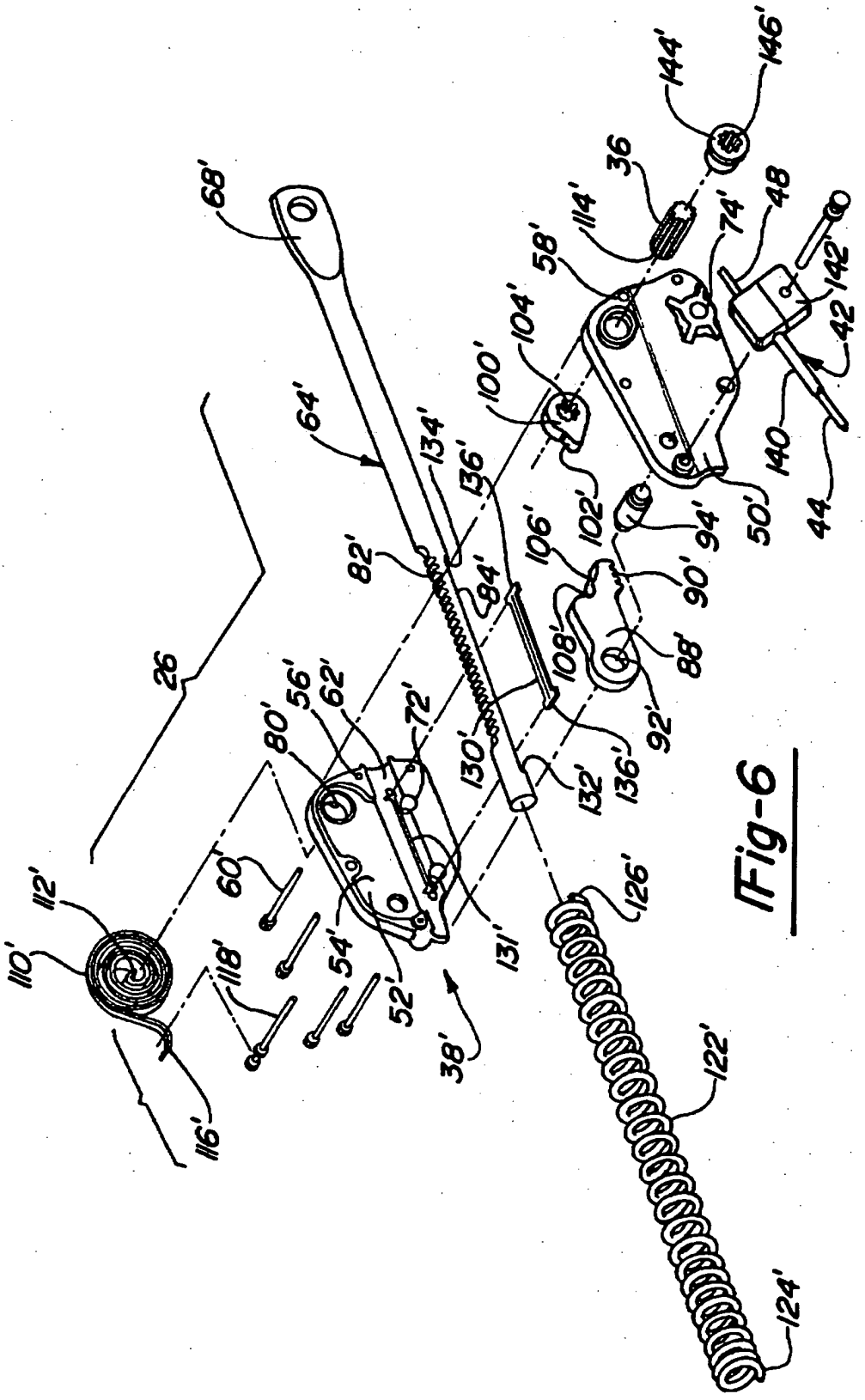
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Fig-6

SIMPLIFIED LINEAR RECLINER

BACKGROUND OF THE INVENTION

This invention relates to linear seat recliners that are operable for angularly reclining the seatback of a vehicle seat into a desired position relative to the seat cushion.

It is commonly desirable to install reclinable seat assemblies in motor vehicles in view of the enhanced comfort and convenience they provide. Such reclinable seat assemblies typically include a seat recliner that can be selectively actuated for adjusting the angular position of the seatback relative to the seat cushion. Traditionally, seat recliners include a pivot mechanism interconnecting the seatback to the seat cushion and a latch mechanism for releasably latching the pivot mechanism. The general arrangement and operation of such a reclinable seat assembly equipped with a linear seat recliner is illustrated by U.S. Pat. No. 4,898,424 and U.S. Pat. No. 5,052,752, each commonly assigned to the assignee of this application and each expressly incorporated herein by reference.

Seat recliners are most commonly of a type utilizing frictional engagement or incremental engagement ("meshing") for releasably latching the seatback in a desired reclined position. In the latter category, many such seat recliners include a latch mechanism having a pawl that vertically reciprocates between a locked position whereat the angular position of the seatback relative to the seat member is established and a retracted position whereat the angular position of the seatback is adjustable by the seat occupant. However, existing seat recliners, particularly those of the incrementally engageable or meshed category, typically require a complicated arrangement of latch elements to generate the locking engagement of the seatback. Thus, a need exists for development of a seat recliner latch mechanism having a simplified yet efficient arrangement for incrementally engaging a recliner rod to establish the angular position of the seatback relative to the seat cushion.

A known shortcoming associated with incrementally engageable latch mechanisms is that they are often the source of undesirable differential movement of the seatback relative to the seat member, commonly referred to as "chucking". Generally, the seat recliner is pivotably connected to the seatback and the seat frame at a first pivot point while the seatback itself is pivotably connected to the seat cushion or the seat frame at a second pivot point. As such, the seatback creates an extremely long lever arm upon which forces are applied, thereby creating various other forces that act upon the pivotable connections of the seatback and the seat recliner itself. These forces, when coupled with "play" between the engaging teeth and tolerances between the components, may cause the seatback to move or "chuck" even when the seat recliner is in its locked position. Movement within and between the seat recliner elements is magnified by the length of the seatback, and generally become noticeable at the upper end of the seat. For example, the seatback of an occupied vehicle seat may tend to oscillate when the vehicle encounters rough road conditions.

One technique that has been employed to reduce chucking is to form the components of the pivot mechanism with exceedingly close tolerances. In other words, the corresponding teeth, as well as the pivot bearings for the rotating components, must be manufactured with very high precision. This technique reduces play in the pivot mechanism and thus reduces chucking. However, manufacturing to such close tolerances is expensive, and such close tolerances may bind the components of the system and prevent smooth operation. Thus, a need also exists for a seat recliner latch mechanism that reduces chucking without requiring exceedingly close tolerances.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a simplified linear seat recliner having a latch mechanism that is selectively operable for establishing the angular position of a seatback relative to a seat cushion.

An addition object of the present invention is to provide a linear seat recliner that reduces chucking, operates smoothly without binding and without requiring excessively close tolerances.

Accordingly, the novel linear seat recliner disclosed herein includes a housing configured to receive a recliner rod for bi-directional linear movement relative thereto and a latch mechanism having a lock pawl supported within the housing for pivotal movement between an unlatched position whereat the recliner rod is movable for adjusting the angular position of the seatback relative to the seat member and a latched position whereat locking teeth on the lock pawl engage a toothed portion of the recliner rod for lockingly establishing the angular position of the seatback relative to the seat member. The lock pawl is urged into its latched position by a spring-biased cam plate, thereby limiting the play between the locking teeth on the lock pawl and the teeth on the recliner rod.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a seat assembly according to a presently preferred embodiment of the present invention illustrating the operational association between a linear seat recliner and a common seat structure;

FIG. 2 is a top plan view of the linear seat recliner which includes a manually-operable "master" latch mechanism and a "slave" latch mechanism that are operatively interconnected for synchronously controlling the inclination of the seatback relative to the seat member shown in FIG. 1;

FIG. 3 is an exploded perspective view of the master latch mechanism shown in FIG. 2;

FIG. 4 is a partial sectional view of the master latch mechanism in its latched position with the seatback in its fully reclined position;

FIG. 5 is a partial sectional view of the master latch mechanism in its released position with the seatback in its fully upright position; and

FIG. 6 is an exploded perspective view of the slave latch mechanism shown in FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1 of the drawings, a seat assembly 10 incorporating an adjustable linear seat recliner 12 according to a presently preferred embodiment of the present invention is shown. More specifically, FIG. 1 illustrates a seat assembly 10 that provides a predetermined range of angular movement between a seat cushion 14 and a seatback 16. To this end, seat recliner 12 functionally interconnects seat cushion 14 and seatback 16 to permit the inclined angle therebetween to be controllably varied. Seatback 16 includes a pair of lateral frame rails 18 (only one shown) that are each coupled to an adjacent lateral frame segment 20 of seat cushion 14 for pivotable movement about a hinge pin 22. Seatback frame rails 18 and seat frame segments 20 are typically fabricated of a relatively rigid material and are

suitably configured to provide stable pivotal motion upon actuation of linear seat recliner 12.

With particular reference to FIG. 2, it is contemplated that seat recliner 12 include both a first or "master" latch mechanism 24 and a second or "slave" latch mechanism 26 that are interconnected by a coupling mechanism 28 for common actuation by manual operation of a release mechanism 30. As described in greater detail hereinafter, release mechanism 30 includes a release handle 32 mounted to an actuator shaft 34 of master latch mechanism 24. Coupling mechanism 28 functions to operatively couple actuator shaft 34 to an actuator shaft 36 of slave latch mechanism 26. Actuator shafts 34 and 36 are supported for rotation within master and slave housing assemblies 38 and 38', respectively, and operable to selectively and synchronously shift master latch mechanism 24 and slave recliner mechanism 26 from a "locked" mode to a "released" mode, thereby allowing a seat occupant to adjust the angular position of seatback 16 relative to seat cushion 14. Those skilled in the art will appreciate that the structure of slave latch mechanism 26 is substantially similar to that of master latch mechanism 24 except that release handle 32 of release mechanism 30 is fixedly coupled (i.e., splined) to actuator shaft 34 of master latch mechanism 24. Preferably, coupling mechanism 28 includes a cable assembly 42 having an inner cable 44 with its first end 46 connected to master actuator shaft 34 and its second end 48 connected to slave actuator shaft 36. While a dual (i.e., master slave) latching arrangement is disclosed, it should also be appreciated that in some seating applications only a single releasable latch mechanism may be needed.

With particular reference now to FIGS. 2 through 5, housing assembly 38 of master latch mechanisms 24 is shown to generally include a first housing portion 50 and a second housing portion 52 connectable to form a cavity 54 accommodating the operative components of the present invention. Specifically, first and second housing portions 50 and 52 respectively include alignable sets of apertures 56 and 58 that are cooperative with screws 60 or other suitable fasteners to secure first and second housing portions 50 and 52 to one another. Housing assembly 38 also includes a longitudinal, generally cylindrical bore 62 adapted to accommodate an elongated recliner rod 64 having a first end 66 adapted to be supported within housing assembly 38 and a second end 68 adapted to be mounted to a lower distal end of frame rail 18 as by fasteners 70. A pair of alignable bores 72 and 74 pass through first and second housing portions 50 and 52 and cooperates with fastener 76 (FIG. 1) to pivotably connect master latch mechanism 24 to frame support 20 associated with seat cushion 14, thereby permitting master latch mechanism 24 to pivot relative thereto upon reciprocable movement of elongated recliner rod 64. In this manner, linear movement of recliner rod 64 relative to housing assembly 38 through a limited range of axial motion defines a corresponding range of angular movement of seatback 16 relative to seat cushion 14. Housing assembly 38 also includes another pair of alignable bores 78 and 80 adapted to journally accommodate externally-splined actuator shaft 34 for rotation therewithin as hereinafter discussed.

As best seen in FIG. 3, a toothed rack 82 is provided on the upper portion of elongated recliner rod 64 proximate to first end 66 thereof while a non-toothed section 84 is located opposite to toothed rack 82. Master latch mechanism 24 further include a lock pawl 88 having teeth 90 and an aperture 92 through which lock pawl 88 is pivotably connected between housing portions 50 and 52 of housing assembly 38 by a pin 94. Teeth 90 are adapted to engage toothed rack 82 on elongated recliner rod 64 when master latch mechanism 24 is in its locked mode, as is hereinafter described.

Master latch mechanism 24 includes a cam plate 100 having a camming tab 102 and an internally-splined aperture 104 that is adapted to mesh with externally-splined actuator shaft 34 for common rotational movement therewith relative to housing assembly 38. Cam plate 100 and lock pawl 88 are supported within cavity 54 of housing assembly 38 such that camming tab 102 of cam plate 100 cooperates with one of a first cam surface 106 and a second cam surface 108 formed on lock pawl 88 to rotate lock pawl 80 to and from a latched position (FIG. 4) from and to an unlatched position (FIG. 5). A biasing mechanism, such as a spiral spring 110, is provided to normally urge lock pawl 88 toward its latched position. In the preferred embodiment, spiral spring 110 includes a first end 112 retained in a slot 114 formed in one end of actuator shaft 34 and a second end 116 retained on a stop pin 118 extending from housing assembly 38. Spiral spring 110 is operable for normally biasing actuator shaft 34 to rotate in a first direction (i.e., counterclockwise in FIGS. 4 and 5) for urging camming projection 102 into engagement with first cam surface 106 of lock pawl 88, thereby normally biasing lock pawl 88 to rotate in a first direction (i.e., clockwise in FIGS. 4 and 5) for forcing teeth 90 into locked engagement with toothed rack 82. To this end, FIG. 4 illustrates lock pawl 88 in its latched position whereat its teeth 90 lockingly engage toothed rack 82 on recliner rod 64 for establishing the locked mode for master latch mechanism 24, thereby preventing linear reciprocable movement of recliner rod 64 relative to housing assembly 38.

Release mechanism 30 is provided to allow a seat occupant to rotate actuator shaft 34 in a second direction (i.e., clockwise in FIGS. 4 and 5), in opposition to the biasing force exerted thereon by spiral spring 110, for lifting lock pawl 88 to its unlatched position whereat its teeth 90 are disengaged from toothed rack 82 on recliner rod 64 for establishing the released mode for latch mechanism 24, thereby permitting movement of recliner rod 64. As seen, release handle 32 has an internally-splined boss 120 meshingly received on externally-splined actuator shaft 34. Thus, release handle 32 is fixed for rotation with actuator shaft 34 of master latch mechanism 24. Handle 32 is located in close proximity to a lateral edge of seat assembly 10 to permit a seat occupant to selectively shift latch mechanism 24 from its normal locked mode into its released mode in response to rotation of actuator shaft 32 in its second direction. In operation, rotation of handle 32 in the second direction results in concurrent rotation of cam plate 100 such that camming projection 102 is forcibly moved into engagement with second cam surface 108 of lock pawl 88. Such action causes lock pawl 88 to rotate about pin 94 to its unlatched position shown in FIG. 5 whereat its teeth 90 are displaced from toothed rack 82 on recliner rod 64. Thereafter, rearward pressure exerted on seatback 16 by the seat occupant causes seatback 16 to pivot about hinge pins 22 for reclining seatback 16. Reclining movement of seatback 16 results in forward linear movement of recliner rod 64 relative to housing assembly 38. To assist in returning seatback 16 toward its upright position from any rearwardly reclined position, seat recliner 12 is further provided with a second biasing mechanism, such as coil spring 122, surrounding recliner rod 64 and having a first end 124 acting against housing assembly 38 and a second end 126 acting against second end 68 of recliner rod 64. Coil spring 122 is preloaded to cause rearward linear movement of recliner rod 64 relative to housing assembly 38 which, in turn, causes

seatback 16 to pivot about hinge pins 22 toward its upright position. As will be appreciated, linear movement, either forward or rearward, is inhibited unless master latch mechanism 24 is in its released mode due to manual operation of release handle 32.

Master latch mechanism 24 is further provided with means for limiting the range of angular movement of seatback 16, thereby defining the fully upright and reclined positions. Accordingly, a stop plate 130 is disposed in an approximately sized chamber 131 within housing cavity 54 for cooperation with non-toothed lower section 84 of recliner rod 64. As best seen in FIGS. 4 and 5, lower section 84 defines a forward stop shoulder 132 and a rearward stop shoulder 134. FIG. 5 illustrates master latch mechanism 24 in its released mode with seatback 16 in its fully upright position such that forward stop shoulder 132 contacts the end of stop plate 130. Similarly, FIG. 4 shows master latch mechanism 24 in its locked mode with seatback 16 in its fully reclined position such that rearward shoulder 134 contacts the opposite end of stop plate 130. Transverse tabs 136 formed on opposite ends of stop plate 130 are provided to nest within corresponding apertures in housing portions 50 and 52 to prevent sliding movement of stop plate 130 within housing assembly 38. As seen in FIG. 4, movement of seatback 16 to its fully reclined position results in forward movement of recliner rod 64 which compresses coil spring 122. Once the occupant removes pressure from seatback 16, coil spring 122 forcibly drives rod 64 rearwardly for moving seatback 16 to its upright position.

FIG. 6 is an exploded view of slave latch mechanism 26 which illustrates its substantial similarity in componentry and function to that of master latch mechanism 24. As such, like components are identified with primed reference numerals.

As noted, coupling mechanism 28 interconnects actuator shaft 36 of slave latch mechanism 26 to actuator shaft 34 of master slave mechanism 24 such that actuation of release handle 32 causes concurrent and synchronous shifting of slave latch mechanism 26 from its locked mode into its released mode in response to shifting of master latch mechanism 24 from its locked mode into its released mode. Spiral springs 110 and 110' are arranged to normal biasing actuator shafts 34 and 36 in a direction to forcibly urge cam plates 100 and 100' to engage lock pawls 88 and 88' for movement toward their respective latched positions. In particular, cable assembly 42 includes a sheathing 140 enclosing inner cable 44 and mounting brackets 142 and 142' for mounting opposite ends of sheathing 140 to housings 38 and 38', respectively. First end 46 of cable 44 extends outwardly from bracket 142 and is fixed to actuator shaft 34 via a locking collar 144. Specifically, first end 46 of inner cable 44 is rigidly secured to locking collar 144 which has an internally-splined portion 146 adapted to meshingly engage the external splines on actuator shaft 34. Similarly, second end 48 of inner cable 44 extends outwardly from bracket 142' and is fixed to actuator shaft 36 via another locking collar 144' that is similarly fixed to actuator shaft 36. In operation, rotation of release handle 32 in the second direction (opposing spiral spring 110) acts to pull on inner cable 44. Such action causes actuator shaft 36 to thus rotate in concert with rotation of actuator shaft 34 for concurrently shifting both latch mechanisms into their released modes.

Turning now to the anti-chuck feature of the present invention, current manufacturing techniques, as previously mentioned, are generally unable to eliminate tolerances that create play in the seat recliner mechanism. In the present invention, not only does the biasing force of spring 110 minimize chucking by taking up the play between pawl teeth 90 and toothed rack 82 on recliner rod 64, but the geometric interrelation between lock pawl 88, cam plate 100 and recliner rod 64 further eliminates this problem. Specifically and as best seen in FIG. 4, lock pawl 88 and cam plate 100 are arranged within housing assembly 38 such that a pawl pivot point defined by the axis of pawl pivot pin 94, the cam plate pivot point defined by the axis of actuator shaft 34 and the pivot axis of housing assembly 38 defined by fastener 76 substantially form the vertices of an equilateral triangle. It will be appreciated by those skilled in the art that such an arrangement equalizes the forces acting thereon, thereby taking up the clearances at the engagement points and eliminating seatback chucking.

Various other advantages and modifications will become apparent to one skilled in the art after having the benefit of studying the teachings of the specification, the drawings and the following claims.

What is claimed is:

1. A seat recliner mechanism for controllably adjusting the position of an angularly adjustable seatback relative to a seat member, said mechanism being responsive to actuation by a seat occupant, comprising:

a recliner rod having a first end and a second end, said first end having a rack of teeth, said second end connectable to one of said seat member and seatback;

a housing connectable to the other of said seat member and said seatback and configured to receive said first end of said recliner rod for linear movement relative thereto;

a pawl having a toothed segment and first and second cam surfaces, said pawl supported from said housing for pivotable movement about a pivot point between a first position whereat said toothed segment of said pawl engages said rack of teeth of said recliner rod thereby preventing linear movement of said recliner rod relative to said housing and a second position wherein said toothed segment of said pawl is disengaged from said rack of teeth of said recliner rod whereby said rod is linearly moveable relative to said housing;

an actuator shaft supported from said housing for rotation relative thereto;

a cam plate fixed for rotation with said actuator shaft and having a camming tab arranged to engage one of said first and second cam surfaces on said pawl;

a release operator fixed to said actuator shaft, said operator movable in a first direction for rotating said actuator shaft and said cam plate such that said camming tab engages said first cam surface on said pawl for forcibly moving said pawl from said first position to said second position;

a biasing mechanism for normally biasing said cam plate such that said camming tab engages said second cam surface on said pawl such that said pawl is normally biased toward said first position.

2. The seat recliner mechanism of claim 1 further including a second biasing mechanism acting between said recliner rod and said housing for urging said seatback to an upright position when said pawl is in said second position.

3. The seat recliner mechanism of claim 1 wherein said first biasing mechanism is a spiral spring having a first end connected to said housing and a second end connected to said cam plate so as to normally urge said cam plate camming tab into contact with said second cam surface of said pawl.

4. The seat recliner mechanism of claim 1 further including motion limiting means for limiting the range of linear

movement of said recliner rod relative to said housing thereby defining a corresponding range of angular movement of said seatback relative to said seat member.

5. The seat recliner mechanism of claim 4 wherein said motion limiting means includes a flat portion formed on said recliner rod at said first end and a stop plate cooperatively disposed within said housing, said flat portion defining a first stop shoulder face and a second stop shoulder, said stop plate having a first end and a second end, said first end of said stop plate abutting said first stop shoulder when said seatback is in its fully reclined position and said second end of said stop plate abutting said second stop shoulder when said seatback is in its fully upright position.

6. A seat recliner mechanism for controllably adjusting the position of an angularly adjustable seatback relative to a seat member, said mechanism being responsive to actuation by a seat occupant, comprising:

a recliner rod having a first end and a second end, said first end having a length of teeth along its top surface, said second end connectable to one of said seat member and seatback;

a housing connectable to the other of said seat member and said seatback and configured to receive a portion of said recliner rod for linear movement relative thereto;

a pawl having a first camming surface, a second camming surface and a tooth, said pawl connected to said housing for pivotable movement about a pawl pivot point between a first position wherein said pawl tooth engages said length of teeth of said recliner rod thereby preventing linear movement of said recliner rod relative to said housing and a second position wherein said pawl tooth is disengaged from said length of teeth of said recliner rod whereby said recliner rod is linearly moveable relative to said housing;

a camming member coupled to said housing for pivotable movement between a locking position wherein said camming member contacts said first camming surface of said pawl at a contact point thereby placing said pawl into said first position and a released position wherein said camming member cooperates with said second camming surface of said pawl to place said pawl into said second position;

first biasing means associated with said camming member for urging said camming member into said locking position; and

release means coupled to said camming member for moving said camming member from said locking position to said released position thereby moving said pawl into said second position to permit the seat occupant to adjust the reclining angle of said seatback relative to said seat member.

7. The seat recliner mechanism of claim 6 further comprising a splined actuating rod and wherein said camming member includes a splined aperture cooperative with said splined actuating rod such that said camming member is coupled for rotation with said splined actuating rod, said splined actuating rod having a longitudinal axis defining said pawl pivot point.

8. The seat recliner mechanism of claim 7 wherein said release means is coupled to said splined actuating rod.

9. The seat recliner mechanism of claim 8 wherein said release means includes a handle connected for rotation to said splined actuating rod.

10. The seat recliner mechanism of claim 6 further comprising motion limiting means for limiting the range of axial movement of said recliner rod relative to said housing so as to define a corresponding range of angular movement of said seatback relative to said seat member.

11. The seat recliner mechanism of claim 10 wherein said motion limiting means includes a flat portion formed on said recliner rod substantially opposite said length of teeth and a stop plate cooperatively disposed within said housing, said flat portion defining a first engagement face and a second engagement face, said stop plate having a first end and a second end, said first end of said stop plate abutting said first engagement face when said seatback is fully reclined, said second end of said stop plate abutting said second engagement face when said seatback is in its fully upright position.

12. A seat assembly comprising:

a seat member;

a seatback;

pivot means for permitting pivotal movement of said seatback relative to said seat member between a reclined position and an upright position;

a recliner rod having a first end and a second end, said first end having a length of teeth, said second end connectable to one of said seat member and seatback;

a housing connectable to the other of said seat member and said seatback and configured to receive a portion of said recliner rod for linear movement relative thereto;

a pawl having a tooth, said pawl connected to said housing for pivotable movement about a pawl pivot point between a first position wherein said pawl tooth engages said length of teeth of said recliner rod thereby preventing linear movement of said recliner rod relative to said housing and a second position wherein said pawl tooth is disengaged from said length of teeth of said recliner rod whereby said rod is linearly moveable relative to said housing;

a camming member pivotably coupled to said housing by a splined actuating rod and moveable between a first position and a second position, said camming member cooperating with said pawl to move said pawl from and to said first position to and from said second position when said camming member is moved from and to said first position to and from said second position;

first biasing means coupled to said housing and one of said pawl and said camming member for urging said pawl into said first position;

releasing means coupled to said housing for rotating said pawl from said first position to said second position; and

second biasing means associated with said recliner rod for urging said seatback into said upright position.

13. The seat assembly of claim 12 wherein said pawl further includes a first camming surface and a second camming surface, said camming member cooperating with said first camming surface to urge said pawl into said first position when said camming member is urged into said first position, said camming member cooperating with said second camming surface to urge said pawl into said second position when said camming member is urged into said second position, and wherein said first biasing means is coupled to said camming member to urge said camming member into said first position.

14. In a seat assembly having a seatback pivotably connected to a seat member and a seat recliner mechanism for controlling the angular position of the seatback relative to the seat member, said seat recliner mechanism comprising:

a master recliner mechanism including a recliner rod, housing, pawl, camming member and first biasing

means, said recliner rod having a first end with a length of teeth and a second end connectable to one of said seat member and seatback, said housing connectable to the other of said seat member and said seatback and configured to receive a portion of said recliner rod for linear movement relative thereto, said pawl having a tooth and connected to said housing for pivotable movement about a pawl pivot point between a first position wherein said pawl tooth engages said length of teeth of said recliner rod thereby preventing linear movement of said recliner rod relative to said housing and a second position wherein said pawl tooth is disengaged from said length of teeth of said recliner rod whereby said rod is linearly moveable relative to said housing, said camming member pivotably coupled to said housing and moveable between a first position and a second position, said camming member cooperating with said pawl to move said pawl from and to said first position to and from said second position when said camming member is moved from and to said first position to and from said second position, said first biasing means coupled to said housing and one of said pawl and said camming member for urging said pawl into said first position;

a slave recliner mechanism including a recliner rod, housing, pawl, camming member and first biasing means, said recliner rod having a first end with a length of teeth and a second end connectable to one of said seat member and seatback, said housing connectable to the other of said seat member and said seatback and configured to receive a portion of said recliner rod for linear movement relative thereto, said pawl having a tooth and connected to said housing for pivotable movement about a pawl pivot point between a first position wherein said pawl tooth engages said length of teeth of said recliner rod thereby preventing linear movement of said recliner rod relative to said housing and a second position wherein said pawl tooth is disengaged from said length of teeth of said recliner rod whereby said rod is linearly moveable relative to said housing, said camming member pivotably coupled to said housing and moveable between a first position and a second position, said camming member cooperating with said pawl to move said pawl from and to said first position to and from said second position when said camming member is moved from and to said first position to and from said second position, said first biasing means coupled to said housing and one of said pawl and said camming member for urging said pawl into said first position;

releasing means interconnecting said master recliner mechanism and said slave recliner mechanism, said releasing means operable by a seat occupant for substantially simultaneously rotating said pawls of said master recliner mechanism and said slave recliner mechanism from said first positions to said second positions whereby the angular position of the seatback and the seat member is variable; and

second biasing means associated with said recliner rod of at least one of said master recliner mechanism and slave recliner mechanism for urging said seatback into said upright position.

15. The seat assembly of claim 14 wherein said camming member of said master recliner mechanism is coupled to said master mechanism housing by a splined actuating rod rotatable within said master mechanism housing, wherein said camming member of said slave recliner mechanism is coupled to said slave mechanism housing by a splined actuating rod rotatable within said slave mechanism housing, and wherein said release means include a release cable having a first end coupled to said splined actuating rod of said master recliner mechanism and a second end coupled to said splined actuating rod of said slave recliner mechanism whereby actuation of said release means rotates said master and slave camming members.

* * * * *

US005299853A

United States Patent [19]

Griswold et al.

[11] Patent Number: 5,299,853

[45] Date of Patent: Apr. 5, 1994

[54] VEHICLE SEAT ASSEMBLY WITH LINEAR ACTUATOR

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[73] Assignee: Hoover Universal, Inc., Plymouth, Mich.

[21] Appl. No.: 12,344

[22] Filed: Feb. 2, 1993

[51] Int. Cl.[5] B60N 2/02; F16N 27/02

[52] U.S. Cl. 297/362.12; 297/362.14; 297/361.1; 297/363; 74/89.15

[58] Field of Search 297/362.12, 362.14, 297/361.1, 363; 74/89.15

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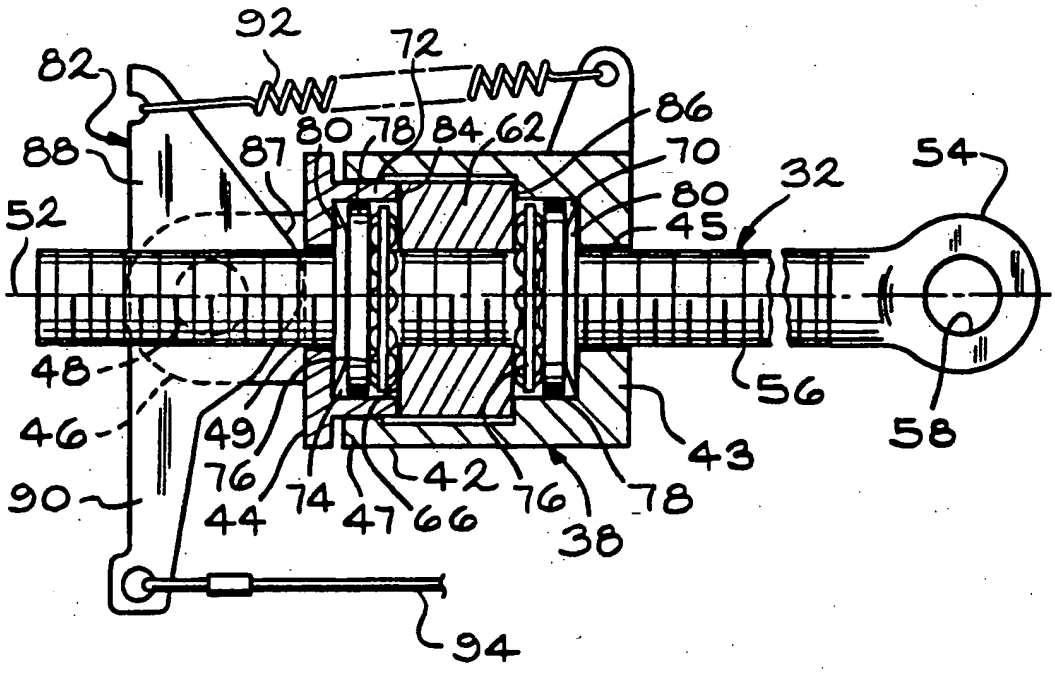
Primary Examiner—Clifford D. Crowder
Assistant Examiner—Bibhu Mohanty
Attorney, Agent, or Firm—Harness, Dickey & Pierce

[57] ABSTRACT

A vehicle seat assembly with a linear actuator is disclosed in which the actuator is used to adjust the relative position of two relatively movable components of the seat assembly. The actuator includes a first part attached to one of the seat assembly components in the form of a lead screw with an external helical screw thread. A second part of the actuator is attached to the other seat component that is relatively movable and includes a housing containing a spin nut threaded onto the lead screw. The second part further includes means for axially capturing the spin nut to prevent the spin nut from rotating along the lead screw and means for selectively releasing the spin nut from its axial capture to permit rotation about the lead screw and thereby relative movement of the actuator second part relative to the first part. A cam is mounted to the second part to selectively engage and release the spin nut from its axial capture.

17 Claims, 8 Drawing Sheets



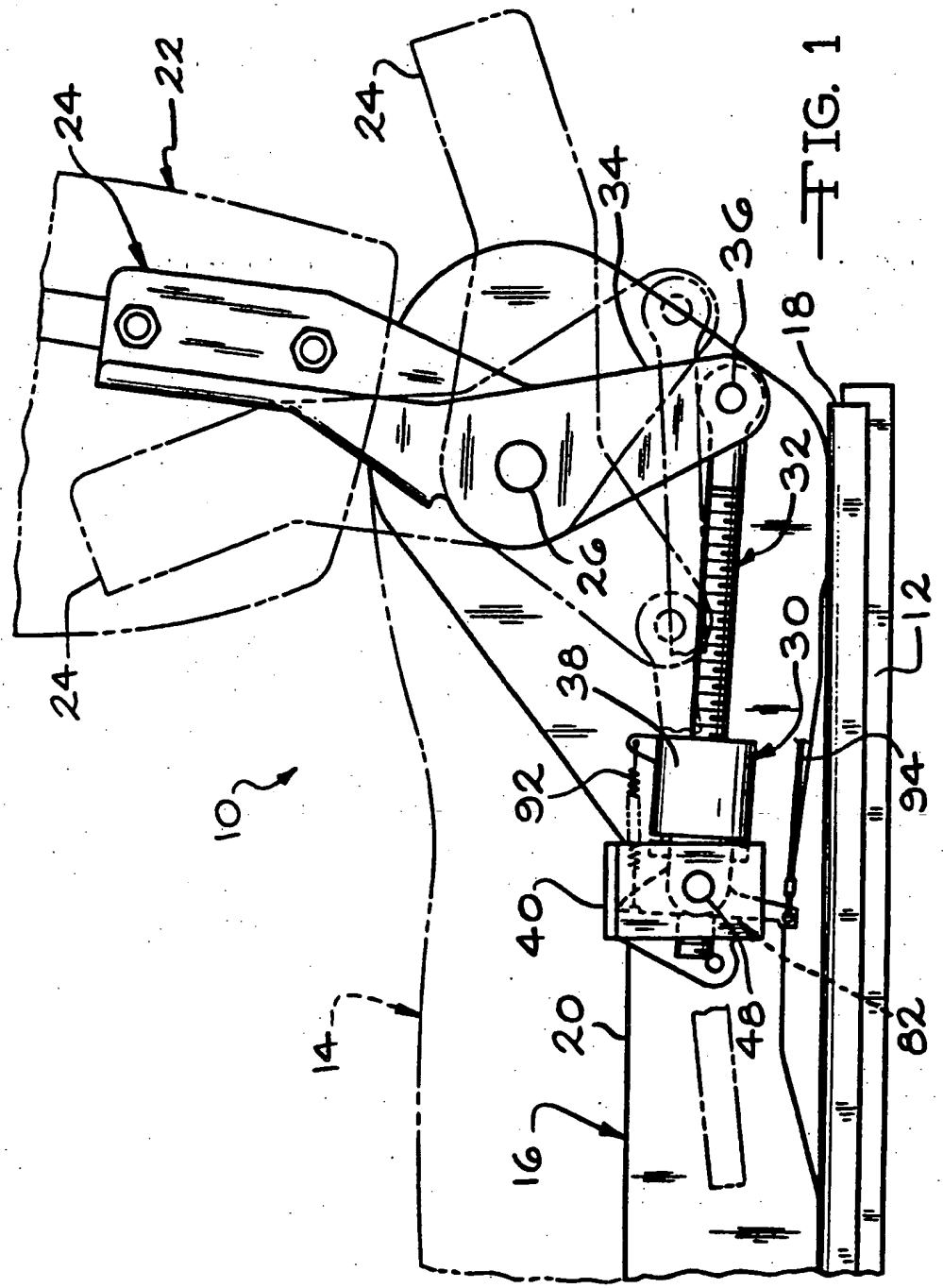


FIG. 1

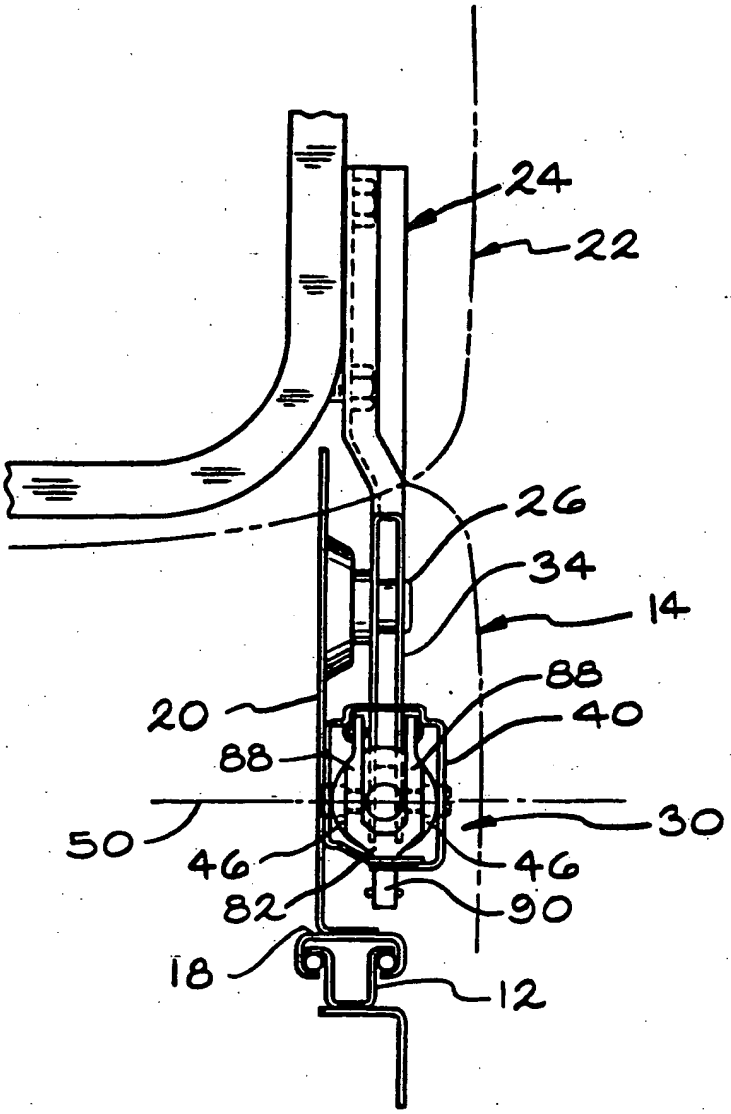
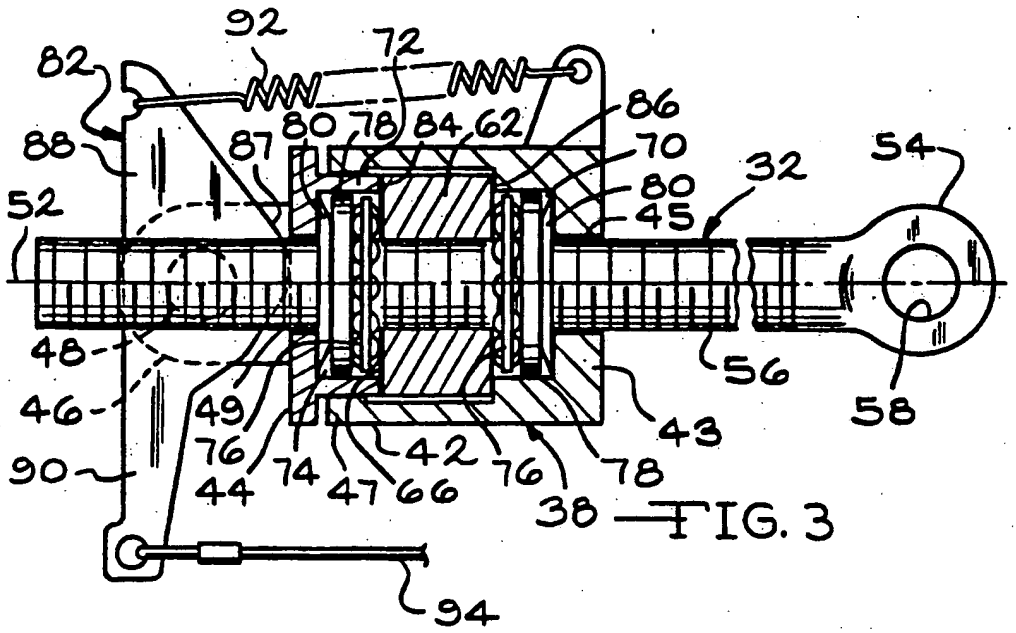


FIG. 2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56
58
90
94

FIG. 3

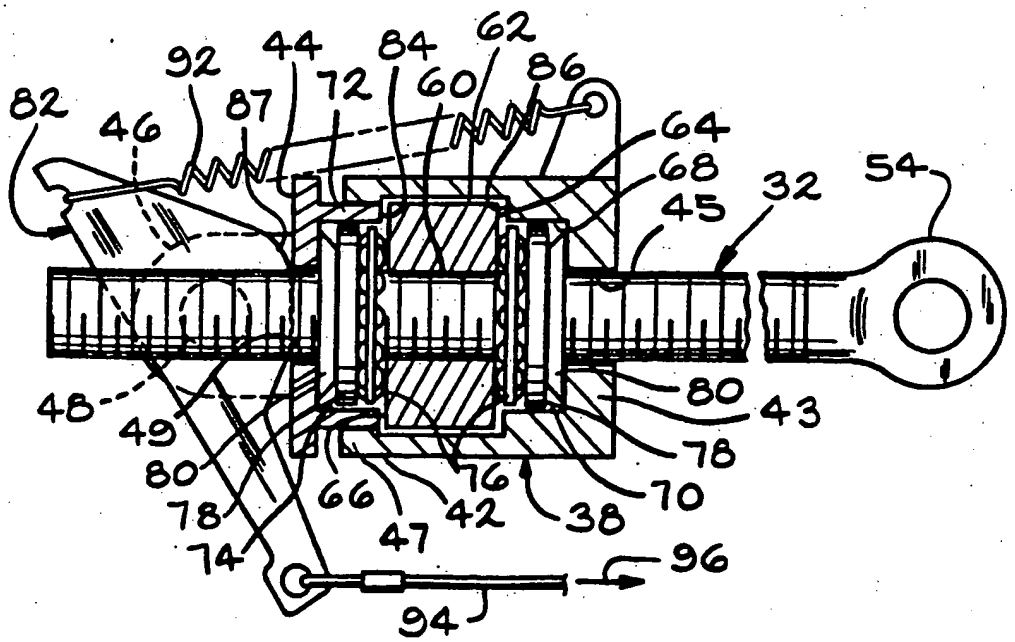
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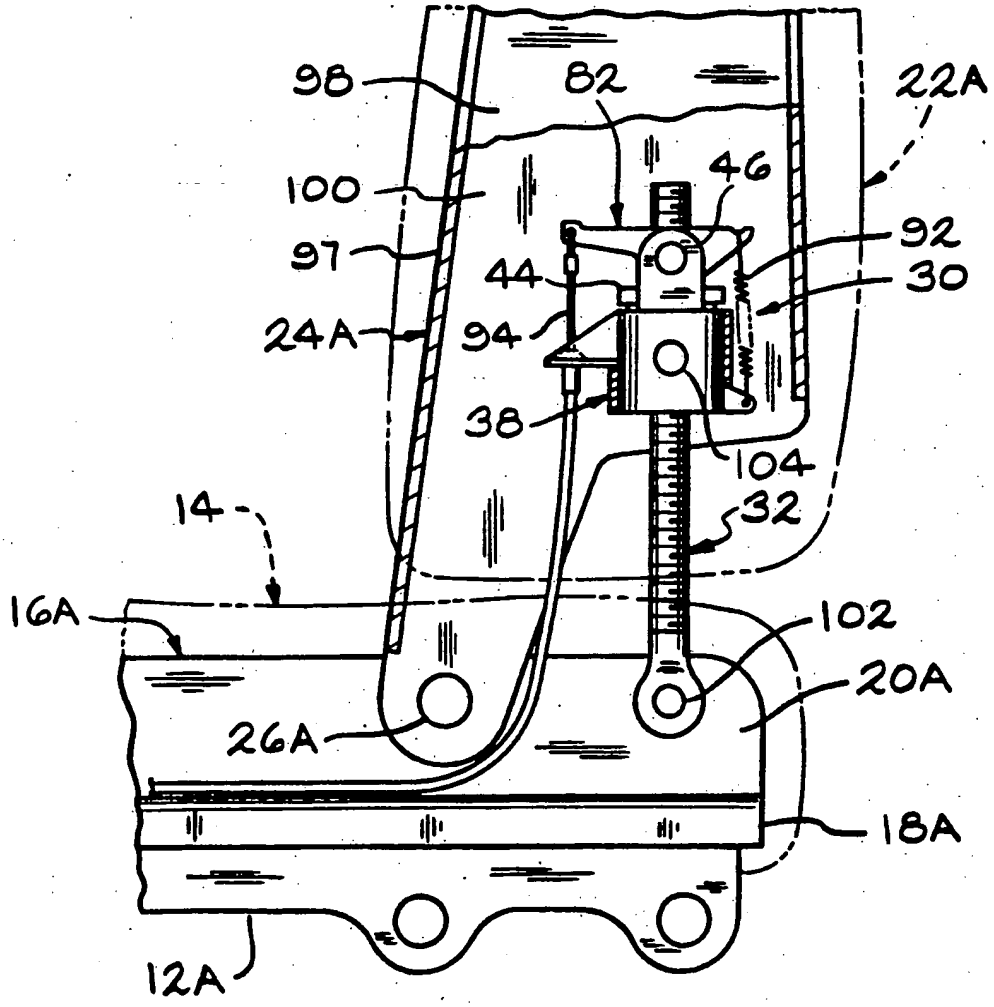
FIG. 4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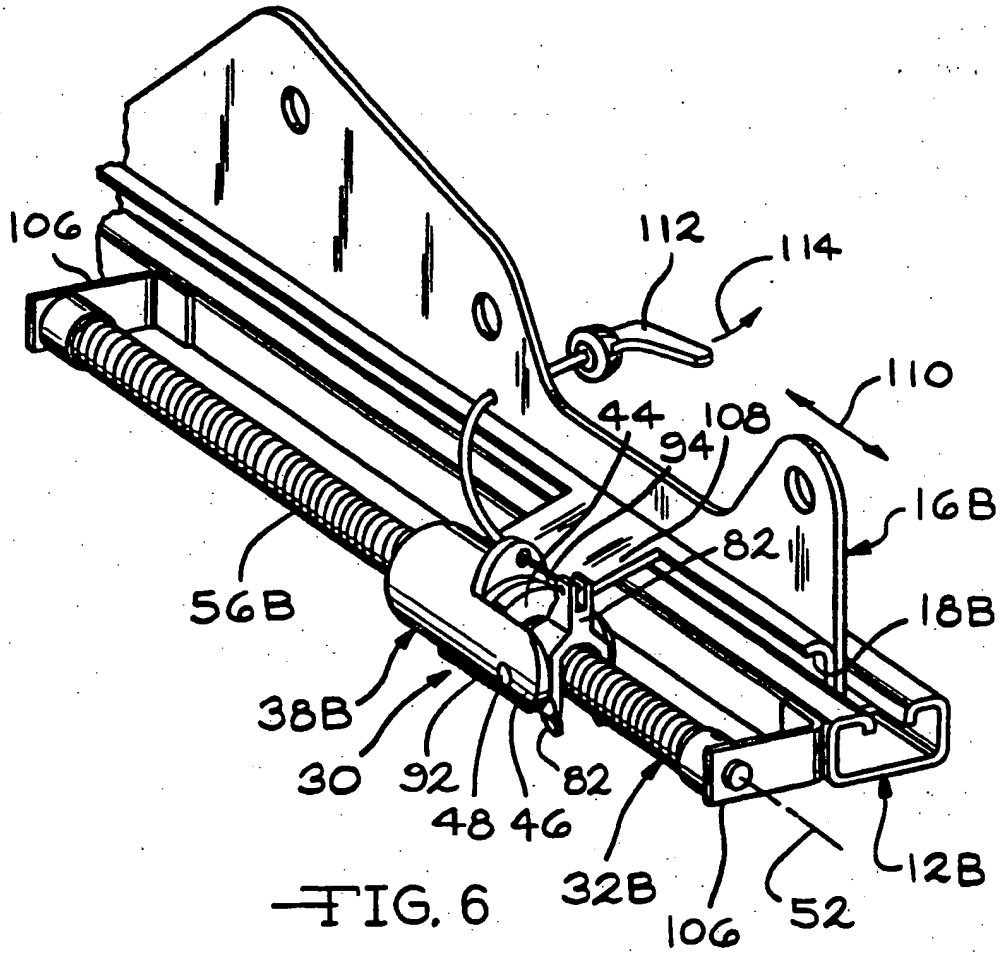
18A
12A

FIG 5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38B
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106
52
12B

FIG. 6

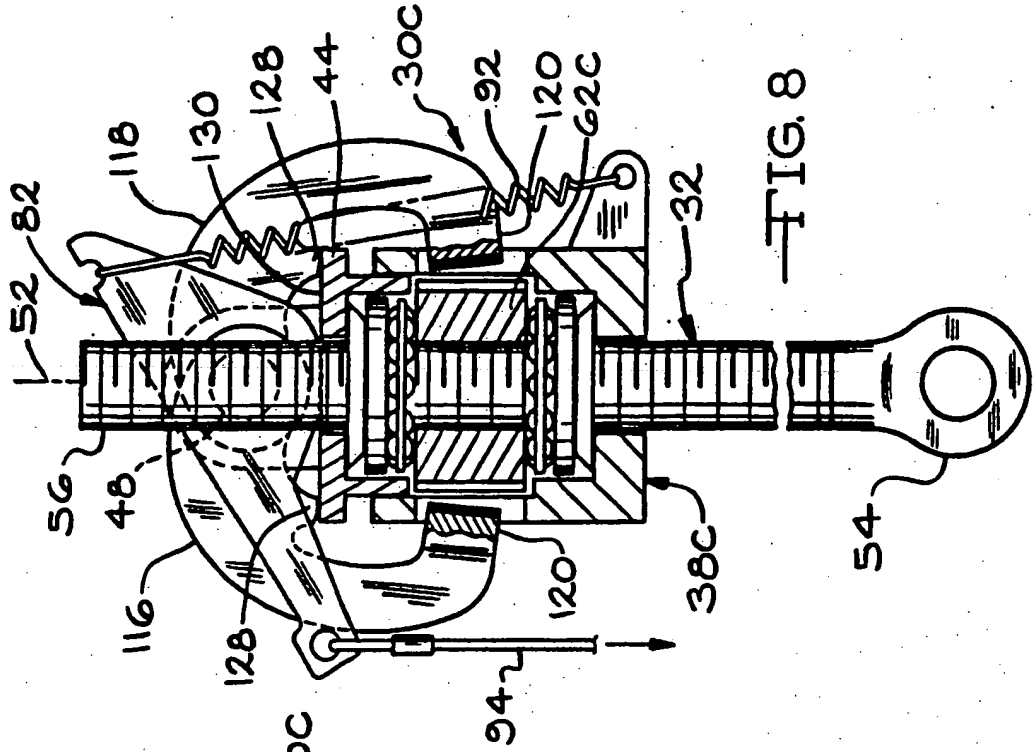
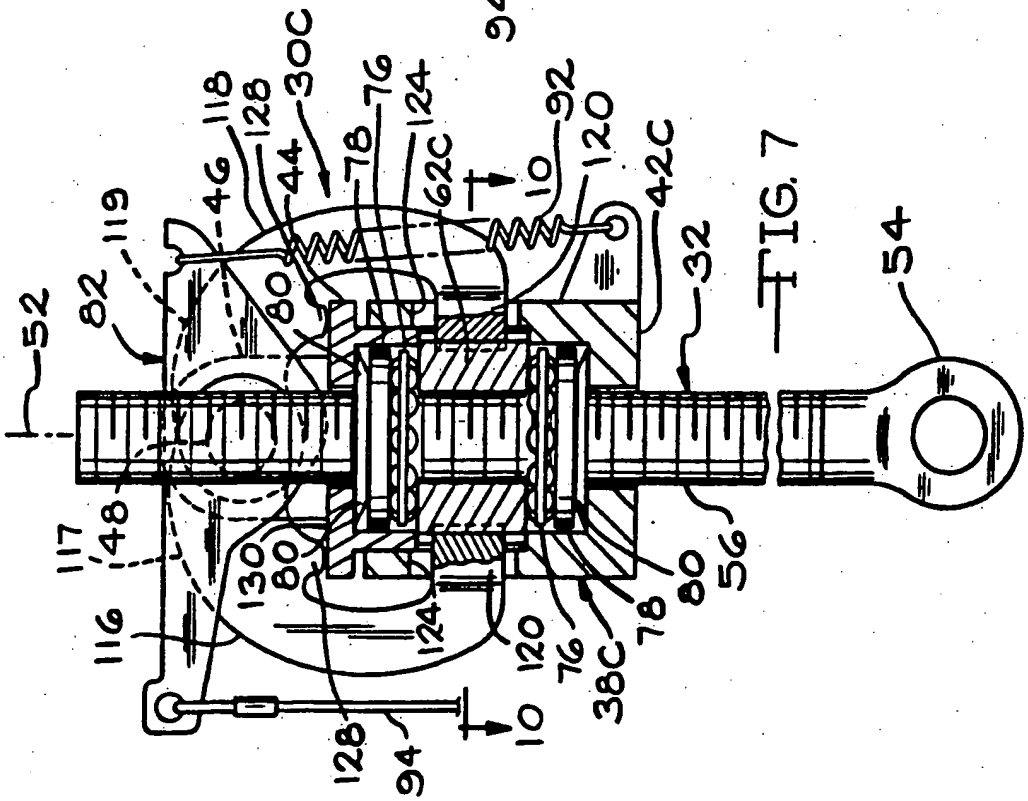

118
130
128
44
30C
92
120
62C
32
82
52
56
48
116
128
120
38C
54
94

FIG. 8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128
30C
76
124
92
120
46
44
78
62C
10
42C
119
82
80
32
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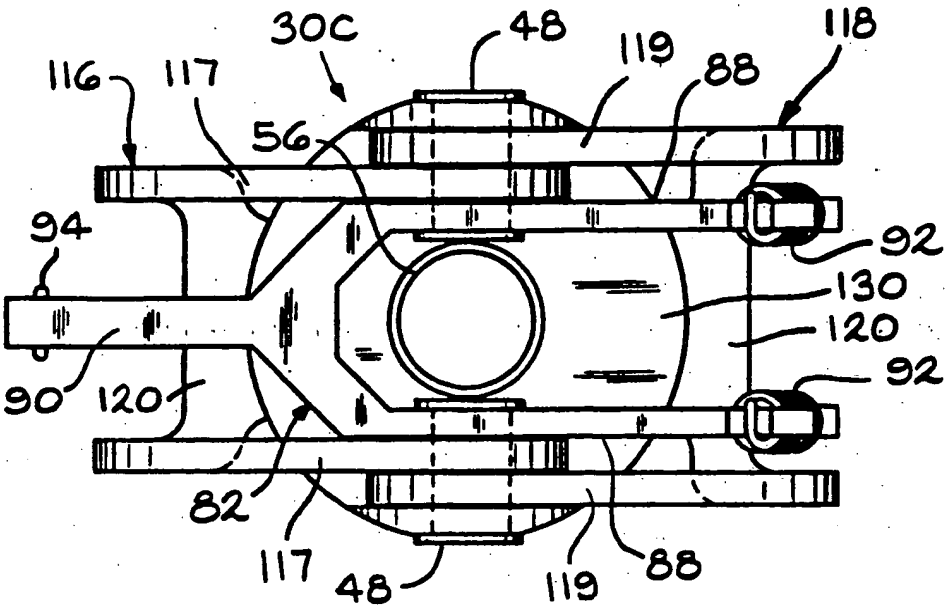
117
48
130
80
116
124
120
76
38C
78
80
56
128
94
10

FIG. 7


30C
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119
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48
119
88

FIG. 9

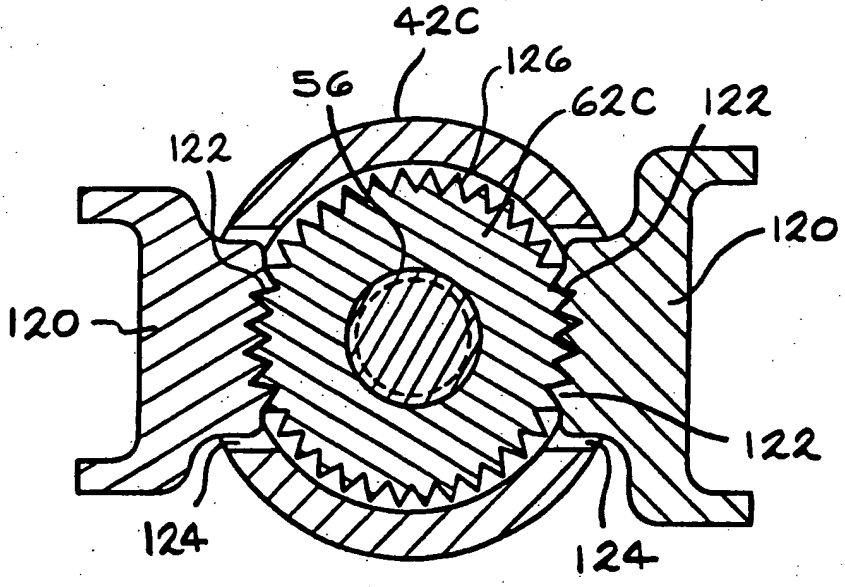
42C
126
56
62C
122
122
120
120
122
124
124

FIG. 10

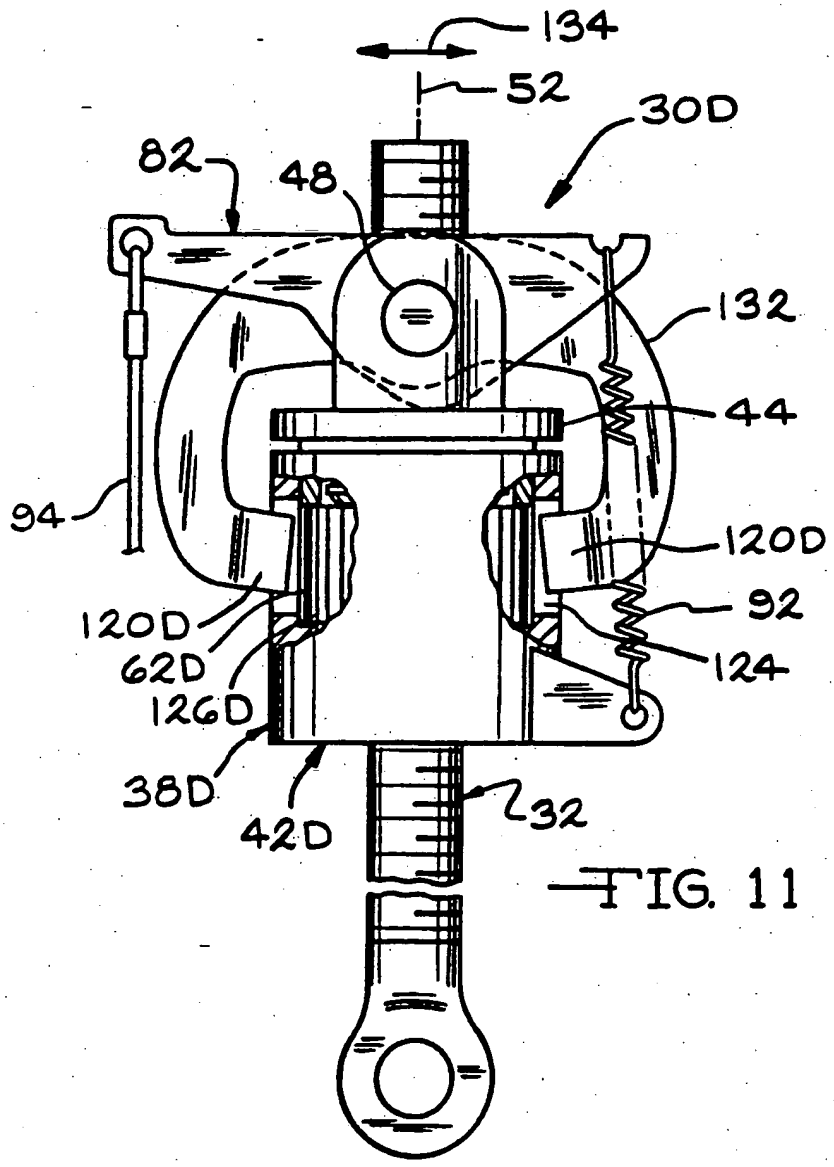

FIG. 11

VEHICLE SEAT ASSEMBLY WITH LINEAR ACTUATOR

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates to vehicle seat assemblies and in particular to vehicle seat assemblies having an linear actuator for use as a seat adjuster and/or a recliner.

Manually adjustable vehicle seat assemblies typically include an adjuster for adjusting the fore and aft position of seat assembly relative to the vehicle and a recliner for adjusting the inclination of the seat back. Such mechanisms must be capable of withstanding the high loads that may be applied to the seat assembly during a vehicle collision. More and more vehicle seat assemblies are being developed with the seat belts mounted directly on the seat assembly rather than being mounted to the vehicle structure. This increases the seat belt comfort because the belt anchors are moved with the seat assembly during adjustment rather than being fixed to the vehicle structure. However, with the seat belts mounted to the seat assembly, the forces applied to the recliner and adjuster mechanisms during a vehicle collision are significantly increased.

Accordingly, it is an object of the present invention to provide a recliner mechanism and a seat adjuster mechanism that are capable of withstanding seat belt loads.

It is a further object of the present invention to provide such devices which, when under high loading conditions, act to "lock up", making relative movement of seat components more difficult as opposed to failing under the high loads in a manner which increases the likelihood of seat component movement.

It is a feature of the present invention to provide a seat assembly with a seat adjuster mechanism or a recliner mechanism which relies upon friction to lock the movable seat components in place. When loaded, the mechanisms are designed to increase the normal force at the friction surfaces, thereby increasing the friction holding the seat components in place.

It is a further feature of the invention that the actuator of the present invention is infinitely variable in some embodiments to allow adjustment to any position desired.

The actuator includes a first part attached to one of the seat assembly components in the form of a lead screw with an external helical screw thread. A second part is attached to another seat component that is movable relative to the component attached to the first part. This second part includes an spin nut having a threaded bore that is threaded onto the lead screw and a housing for axially capturing the spin nut. The housing includes an end cap that is axially movable between a lock position in which the axial end walls of the spin nut are frictionally engaging the cap and the housing to prevent rotation of the nut along the lead screw and a release position in which the spin nut is freed for rotation. The end cap movement is controlled by a cam engaging an outer surface of the cap and an internal spring urging the end cap away from the housing.

Further objects, features and advantages of the invention will become apparent from a consideration of the following description and the appended claims when taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary side elevational view of the structure of the seat assembly of the present invention showing the infinitely variable linear actuator used as a recliner mechanism;

FIG. 2 is a front elevational view of the mechanism shown in FIG. 1;

FIG. 3 is a sectional view of the actuator shown in a locked position;

FIG. 4 is a sectional view of the actuator shown in a released position for seat back adjustment;

FIG. 5 is a fragmentary elevational view of the seat structure showing an alternative embodiment of the recliner mechanism;

FIG. 6 is a perspective view of the seat structure showing the actuator used as a seat adjuster;

FIG. 7 is a sectional view of an alternative embodiment of the actuator with a secondary locking latch shown with the mechanism shown in a locked position;

FIG. 8 is a sectional view of the mechanism of FIG. 7 shown in a released position;

FIG. 9 is a plan view of the mechanism shown in FIGS. 7 and 8;

FIG. 10 is a sectional view as seen from substantially the line 10—10 of FIG. 7; and

FIG. 11 is another embodiment of the actuator mechanism including a secondary inertia locking feature.

DETAILED DESCRIPTION OF THE INVENTION

The seat assembly of the present invention, having an infinitely variable linear actuator for a recliner mechanism is shown in FIG. 1 and designated generally as 10. Seat assembly 10 includes a base member 12 which is attachable to a vehicle floor. A seat member 14 is slidably mounted to the base member 12 and includes a seat frame 16 comprised of a slide rail 18, slidably mounted to the base member 12, and a riser 20. A seat back or back member 22, having a back frame 24, is pivotally mounted to the riser 20 at a pivot joint 26. The pivotal connection of the back frame to the riser enables the back frame and hence the back member to be rotated relative to the seat member as shown by the phantom line positions of the back frame 24. This enables the inclination of the back member 22 relative to the seat member 14 to be adjusted for the comfort of a seat occupant. An infinitely variable linear actuator 30 is used to hold or lock the back member in place relative to the seat member.

The actuator 30 includes a first part 32 pivotally attached at a pivot joint 36 to a recliner arm 34 of the back frame 24. The recliner arm extends downward from the pivot joint 26 that attaches the back frame to the riser. The first part 32 is allowed to pivot about a horizontal transverse axis but is not allowed to pivot about the axis 52 described below.

A second part 38 of the actuator is pivotally attached to the riser through a mounting bracket 40. The actuator 30 includes an internal mechanism, shown in FIGS. 3 and 4 which operates to lock the first part 32 relative to the second part 38, thus locking the back frame 24 to the seat frame 16, preventing relative motion therebetween. The second part 38 of the actuator includes a housing 42 having an end wall 43 at one end with a central aperture 45 therethrough. The opposite end 47 of the housing is open. An end cap 44 with a central aperture 49 is positioned in the open end so as to close

the housing. A pair of mounting flanges 46 extend from the housing 42 and are coupled to the mounting bracket 40 at the pivot joint 48. This allows the second part 38 of the actuator to pivot relative to the seat frame 16 about a horizontal transverse axis 50.

The actuator 30 comprises a central linear axis 52 which passes through the points of attachment 36 and 48 of the actuator to the back frame 24 and seat frame 16 respectively. The attachment of a first part 32 to the recliner arm 34 of the seat frame comprises an eyelet 54 formed at one end of a shaft 56 which extends along axis 52. The eyelet 54 comprises a circular aperture 58 and its attachment to the recliner arm 34 is made by a circular pivot pin (not shown) being passed through the aperture 58 and a corresponding aperture in the recliner arm 34.

The shaft 56 is formed on its exterior surface with a threaded portion comprising a plurality of threads extending in the helical fashion around the outside of the shaft over a significant portion of its length as illustrated. The shaft 56 is operatively coupled with a complementary threaded portion 60 of an annular element 62 (FIGS. 3 and 4). The annular element 62 has its threaded portion 60 on its central bore which is concentric with the axis 52. In its preferred form, element 62 is of a circular outside diameter with spaced axial end walls or end faces 64 and 66 disposed in planes at a right angle to the axis 52.

The housing 42 includes a bore 68 at the closed end of the housing forming a recess 70 of a diameter less than that portion of the housing containing the annular element 62. The end cap 44 includes a cylindrical flange 72 extending into the housing 42 forming a recess 74 within the end cap that is similar to the recess 70.

Disposed within each recess is a circular array of bearings 76, an annular bearing race 78 and a yieldable resilient annular member 80. These members assist in positioning the annular element 62 within the housing 42. As illustrated, the yieldable resilient annular elements 80 are in the form of spring washers sometimes referred as Belleville washers.

Particular reference to FIG. 3, the end cap 44 is shown in a locked position in which it is forced into the housing 42 by a cam lever 82, described in greater detail below. In the locked position of the end cap, the yieldably resilient annular elements 80 are both compressed to the point that the end 84 of the cylindrical flange 72 contacts an outer annular portion of the axial end wall 66 of the annular element 62. Likewise, the shoulder 86 formed in the housing by smaller diameter bore 68, contacts an outer annular portion of the end wall 64 of the annular element 62. The friction between the two end walls 64 and 66 and the shoulder 86 and cylindrical flange 72 prevents rotation of the annular element 62 within the housing 42 about the axis 52. The mounting of the first part 32 to the recliner arm 34 prevents rotation of the first part 32 about the axis 52 while the mounting of the second part 38 to the seat frame 16 precludes rotation of the second part relative to the axis 52. Therefore, with the annular element 62 being prevented from rotating, the first and second parts of the actuator 30 are fixed in position relative to one another which in turn fixes the back frame 2 in position relative to the seat frame 16.

With reference to FIG. 4, the end cap 44 is shown in a release position in which it has been partially withdrawn from the open end of the housing 42. This has been permitted by rotation of the cam lever 82 decreasing the distance between pivot joint 48 and the cam surface 87 along the direction of axis 52. This enables the yieldably resilient annular elements 80 to move the end cap 44 axially toward the pivot joint 48. This disengages the cylindrical flange 72 from the annular element and also disengages the annular element from the shoulder 86 in the housing 42.

Each array of bearings comprises a retainer which serves to retain individual bearing balls. It is these bearing balls which provide rolling contact with the corresponding race 78 and the corresponding end wall 64 or 66 of the annular element 62. In this way, the bearing balls serve to facilitate free rotation of the element 66 between the walls which axially capture it when the mechanism is in an unlocked condition as shown in FIG. 4. In the unlocked condition, when axial forces are applied to the actuator 30, the threaded coupling between the shaft 56 and the annular element 62 enables the annular element 62 to rotate about the axis 52. This in turn causes translation of the first part 32 relative to the second part 38 thus changing the distance between the pivot joint 36 and the pivot joint 48.

The cam lever 82 is a forked lever having two legs 88 extending from a center portion 90. The cam lever is forked to provide a center clearance for the shaft 56 to extend therethrough. The two legs 88 are each pivotally mounted to the flanges 46 by the pivot joint 48. A pair of bias springs 92, each coupled to one of the legs 88 of the cam lever, acts to bias the cam lever to the locked position shown in FIG. 3. A control wire 94 is connected to the center portion 90, opposite the pivot joint 48 from the bias spring 92, and serves to limit the rotational travel of the cam lever in the direction of rotation urged by the springs 92.

The cam lever 82 has an irregular shaped cam surface 87. The axial distance between the pivot joint 48 and the cam surface varies depending upon the rotational position of the cam lever. In the locked position of the cam lever, the axial distance between the pivot joint 48 and the cam surface 87 is greater than when the cam lever is in the unlocked position shown in FIG. 4. As a result, in the locked position, the end cap 44 is positioned further from the pivot joint 48 than in the unlatched position shown in FIG. 4.

A hand operated control lever (not shown) is coupled to the control wire 94 in a conventional manner to pull on the wire 94 in the direction of the arrow 96 of FIG. 4 to unlock the actuator 30. When the wire 94 is pulled, the cam lever is rotated to the release position, enabling the annular element 62 to spin. This enables adjustment of the back frame 24 relative to the seat frame. Upon release of the lever, the bias springs 92 will automatically return the actuator to the locked position. During a vehicle collision, if forces are applied to the seat back in a direction to rotate the seat back forward, the shaft 56 will be placed in tension causing the annular element 62 to be forced against the shoulder 86 with a greater force than applied by the end cap and cam. This increases the frictional force at that interface and thereby increases the resistance to rotation of the annular element 62 tending to "lock-up" the actuator during a period of high loading. If the seat back is loaded in the opposite direction, placing the shaft 56 in compression, the annular element 62 will be forced against the cylindrical flange 72 thus increasing the friction at that interface and increasing the resistance to rotation of the annular element.

The actuator can embody an inertia locking feature by virtue of the construction which has already been described. This would be particularly useful in the event that inertia loads are encountered when the end cap 44 is in a condition other than a fully locked condition. For example, if the mechanism is not fully locked and the vehicle is involved in a sudden deceleration, such as panic braking or a collision, the application of inertia forces arising out of the deceleration can be effective to cause the element 62 to be urged axially within its axial capture so that one of its end walls forcefully abuts the corresponding axial confining surface 84 or 86, depending on the direction of inertia forces. Hence, such inertia forces can be effective to lock element 62 against rotation and thereby resist collapse or extension of the actuator which might otherwise occur. Such inertia locking capability is created by a suitable selection of the yieldability of the annular elements 80 since they must yield to permit the inertia locking action to take place.

The actuator 30 is shown in a alternative installation for use as a recliner mechanism. The actuator 30 is in all respects identical to the actuator shown and described in FIGS. 1 through 4. It is the seat assembly itself that differs between the embodiment shown in FIGS. 1 through 4 and the embodiment shown in FIG. 5. Identical elements are given the same reference numerals while elements that have been modified are given the same reference numeral with the lower case "a" as a suffix. The back frame 24*a* is in the form of a closed section beam 97 with the actuator 30 mounted within the beam. The beam 97 is used when a shoulder belt is mounted to the seat back to provide added strength to accommodate the belt loads. The two flanges 46 of the actuator are pivotally mounted to the side walls 98 and 100 of the beam 24*a*. The actuator 30 is mounted to the seat assembly with the first part 32 pivotally mounted to the seat frame 16*a* at the pivot joint 102 while the second part 38 of the actuator is mounted to the back frame 24*a* through the pivot joint 104.

With reference to FIG. 6, the infinitely variable actuator 30 is shown in use as a seat adjuster to lock the seat in the fore and aft adjusted position. Components of the seat assembly in FIG. 6 identical to those in FIGS. 1–4 are given the same reference numerals while those components that are similar to that disclosed in FIGS. 1–4 are given the same reference numeral with the suffix "b". In most respects, the actuator 30 of FIG. 6 is identical to the actuator 30 in FIGS. 1–4. The first part of the actuator 32*b* is a screw shaft 56*b* that is mounted at its two axial ends to the base member 12*b* through mounting flanges 106 extending laterally from the base member 12*b*. Shaft 56*b* is not rotatable about the axis 52. The second part 36*b* of the actuator is mounted to the seat frame 16*b* through a mounting flange 108. As in the previous embodiments, the first part 32*b* is fixed from rotating about the axis 52.

The seat frame 16*b* is slidably mounted to the base member 12*b* for fore and aft sliding motion in the direction of arrow 110. With the base part 12*b* fixed to a vehicle floor pan, movement of the seat frame 16*b* accomplishes fore and aft adjustment of the seat assembly within the motor vehicle. With the actuator 30 in a locked condition, the annular element 62 within the second part 38*b* is fixed from rotating and thereby prevents movement of the seat frame 16*b* relative to the base part 12*b*. When the wire 94 is pulled by rotation of the release lever 112 in the direction of arrow 114, the cam lever 82 is rotated about the pivot 48, releasing the frictional capture of the annular element 62 allowing the element to rotate and the seat frame 16*b* to move relative to the base part 12*b*.

The seat assembly would typically include a second actuator 30 mounted to a base frame 12*b* and seat frame 16*b* at the opposite lateral side of the seat assembly. A second wire 94 can be coupled to the actuator 30 at the opposite side of the seat assembly and actuated by the release lever 112 for simultaneous release of the two actuators 30.

An alternative embodiment of the actuator, is shown in FIGS. 7–10 and designated generally as actuator 30*c*. As before, identical components are given the same reference numeral while modified components are given the same numeral with the suffix "c". The operation of actuator 30*c* is the same as actuator 30 described in detail above. Actuator 30*c* includes an additional secondary locking mechanism to prevent rotation of the annular element 62*c*. The secondary locking mechanism requires that the actuator be used positioned with the axis 52 oriented vertically.

The secondary locking mechanism includes a pair of lock levers 116 and 118 rotatably mounted to the mounting flanges 46 at the pivot joint 48. The locking levers 116 and 118 are forked so as to be positioned on both sides of the shaft 56 as shown in FIG. 9. The locking levers 116 and 118 are generally C-shaped and are mounted at their upper ends at the pivot joint 48. The lower ends of the locking levers form pawl portions 120 having a plurality of teeth 122. The housing 42*c* includes openings 124 on opposite sides adjacent to the annular element 62*c*. The pawl portions 120 of the two locking levers extend through the openings 124.

The annular element 62*c* is provided with axially extending teeth 126 about its periphery which are engagable with the teeth 122 of the locking levers. The forked arms 117 and 119 on the locking levers each include a downwardly projecting cam portion 128 which rests upon the top surface 130 of the end cap 44. When the end cap is in the locked position as shown in FIG. 7, the end cap 44 is pushed away from the pivot joint 48 a sufficient distance that the two locking levers, due to gravitational forces, are rotated to a position in which the teeth 122 of the locking levers engage the teeth 126 of the annular element 62*c*, thus preventing rotation of the annular element.

When the end cap 44 is moved to an unlocked position as shown in FIG. 8 upon rotation of the cam lever 82, the top surface 130 of the end cap 44 exerts an upward force on the locking levers at the cam portions 128. Due to the horizontal offset between the cam portions 128 and the pivot joint 48, this upward force causes a rotation of the locking levers 116 and 118 about the pivot joint 48, withdrawing the pawl portions 120 of the locking levers from the annular element 62*c* and out of engagement with the teeth 126 of the annular element 62*c*. This frees the annular element 62*c* for rotation about the actuator axis 52 allowing the first part 32 of the actuator 30*c* to move relative to the second part 38*c*. Upon release of the pawl wire 94 and return of the cam lever 82 to the locked position, gravity will return the locking levers 116 and 118 to engagement with the annular element 62*c*.

A last embodiment of the actuator 30 is shown in FIG. 11 designated generally as 30*d*. Like actuator 30*c*, actuator 30*d* is intended for use with the central axis 52 oriented vertically. Actuator 30*d* includes a secondary

locking mechanism having a single locking lever **132**. Locking lever **132** is generally C-shaped but is mounted at its center for rotation at the pivot joint **48** and has two pawl portions **120***d* with teeth engagable with the teeth **126***d* of the annular element **62***d*. The locking lever **132** extends in opposite directions from the pivot joint **148** with the pawl portions **120***d* engagable on opposite sides of the annular element **62***d*.

In addition to being oriented vertically, the actuator **30***d* should also be oriented with the locking lever **132** extending in the direction of anticipated loading applied to the seat assembly into which the actuator **30***d* is installed. The anticipated loading direction is indicated by the arrow **134**. When used as a seat assembly recliner, the loading direction will be in the fore and aft direction Without any load being applied to the seat assembly, the locking lever **132** will be positioned with the two pawl portions **120***d* spaced from the annular element **62***d*. During loading in the direction of arrow **134**, the inertia of the locking lever **132** will cause it to rotate in one direction or the other about the pivot joint **48**. This will cause one of the two pawl portions **120***d* to move into the housing **42***d* where the teeth of the pawl portion will engage the teeth **126***d* of the annular element **62***d*. The engagement between the teeth of the pawl portion and the annular element will prevent rotation of the annular element.

Because the locking lever **132** is normally not in locking engagement with the annular element **62***d*, there is no need for the locking lever to rotate upon unlocking of the actuator **30***d* when the end cap **44** is raised to an unlocked position. Accordingly, there are no cam portions on the locking lever **132** similar to the cam portions **128** of the locking levers in the actuator **30c**.

The seat assembly of the present invention includes a linear actuator used as either a recliner mechanism or a seat adjuster mechanism. The linear actuator operates by frictional engagement with a spin nut to prevent the spin nut from rotating along a lead screw to hold the seat components in their adjusted positions. By using frictional engagement to prevent rotation of the spin nut, the actuator is made to lock-up upon axial loading by increasing the frictional forces acting on the spin nut and thus increasing its resistance to rotation. By providing the actuator with a cam action release lever, the actuator can be released with the use of a simple pull cable in a manner well know in manually adjustable seat assemblies.

It is to be understood that the invention is not limited to the exact construction illustrated and described above, but that various changes and modifications may be made without departing from the spirit and scope of the invention as defined in the following claims.

We claim:

1. An actuator for a motor vehicle seat assembly, said seat assembly having a base member for attachment to a motor vehicle, a seat member mounted to said base member for translational movement relative to said base member and a back member mounted to said seat member for rotation relative to said seat member, said actuator holding one of said seat member or back member in position relative to said base member or said seat member respectively, said actuator comprising:

an elongated lead screw having a pair of ends and defining central linear axis of said actuator, said screw being attached to one of said base member, seat member and back member, said screw having a threaded portion comprising a plurality of threads which extend in a helical fashion around the outside of said screw;

a spin nut having a central bore with a complementary threaded portion, said nut being threadably coupled to said screw and being axially movable along said screw in response to rotation of said spin nut about said axis, and said nut having axial end walls disposed in planes at a right angle to said central axis;

a housing having two ends mounted to another of said base member, seat member and back member, and containing said spin nut therein, said housing having an end wall at one end with an inner face in confronting juxtaposition with one end wall of said nut and said housing being open at the other end;

an end cap slidably disposed in said housing open end having an inner face in confronting juxtaposition to the other end wall of said spin nut to axially capture said nut between said inner faces, said cap further having an outer face opposite said inner face, said end cap being axially slidable in said open end between a lock position in which said inner faces forcefully engage said end walls of said spin nut to prevent rotation of said spin nut about said central axis and a release position in which said inner faces do not engage said end wall thereby permitting said nut to rotate about said axis;

bearing means within said housing to promote free rotation of said nut with respect to said screw;

yieldable resilient means within said housing to urge said end cap to said release position and to urge said nut away from said inner faces whereby said nut is free to rotate;

a cam rotatably mounted to said housing having a cam surface engaging said outer face of said cap, said cam having a first position in which said cam holds said end cap in opposition to said yieldable resilient means in said lock position of said end cap and said cam having a second position in which said end cap is allowed to be moved to said release position by said yieldable resilient means;

bias means for urging said cam to said first position whereby said nut is frictionally held from rotation; and

release means for rotating said cam in opposition to said bias means to said second position whereby said nut is permitted to rotate about said screw.

2. The seat assembly of claim 1 wherein said lead screw ends are each attached to said base member and said housing is attached to said seat member whereby said actuator is operable as a seat adjuster to position said seat member upon said base member.

3. The seat assembly of claim 1 further comprising:

first pivotal attaching means for pivotally attaching one end of said lead screw to one of said seat member and said back member and having a first pivot axis normal to said central axis; and

second pivotal attaching means for pivotally attaching said housing to the other of said seat member and said back member and having a second pivot axis normal to said central axis whereby said actuator is operable to rotatably position said back member relative to said seat member.

4. The seat assembly of claim 3 wherein on end of said lead screw is pivotally attached to said back member and said housing is pivotally attached to said seat member whereby said actuator is operable to rotatably position said back member relative to said seat member.

5. The seat assembly of claim 4 wherein said central linear axis is oriented generally horizontal.

6. The seat assembly of claim 3 wherein one end of said lead screw is pivotally attached to said seat member and said housing is pivotally attached to said back member whereby said actuator is operable to rotatably position said back member relative to said seat member.

7. The seat assembly of claim 6 wherein said central linear axis is oriented generally vertical.

8. The seat assembly of claim 3 wherein said cam is rotatably attached to said housing by said second pivotal attachment means.

9. The seat assembly of claim 8 wherein said cam is a forked member having a base portion extending radially relative to said second pivot axis to one side of said actuator and a pair of spaced parallel legs extending in radially relative to said second pivot axis to the opposite side of said actuator from the base portion of said cam, said legs each having axially protruding cam portions with edge surfaces engaging said outer face of said end cap.

10. The seat assembly of claim 9 wherein said central axis extends between said spaced legs of said cam.

11. The seat assembly of claim 8 further comprising a pair of flanges extending axially from the open end of said housing, and said second pivotal attachment means being formed in said flanges to mount said housing through said flanges.

12. The seat assembly of claim 1 further comprising:

first pivotally attaching means for pivotally attaching a first end of said lead screw to said seat member with said lead screw extending generally vertically upwardly from said first end; and

a second pivotal attaching means for pivotally attaching said housing to said back member; and wherein:

said spin nut has a circular outer periphery;

said housing comprises a tubular body with a cylindrical side wall parallel to said central axis, said tubular body being open at an upper end and having an end wall at a lower end of said side wall, said end wall having an aperture for said lead screw to pass therethrough, and a pair of mounting flanges extending axially upward from said tubular body at the open upper end of said side wall, said flanges being diametrically opposite one another and said second pivotal attaching means connecting said flanges to said back member to pivotally attach said housing, said cylindrical side wall further having a pair of diametrically opposite side wall openings therein adjacent said spin nut in said housing; and

means pivotally mounted to said flanges at said second pivotal attaching means and movable through said side wall openings for engaging said spin nut to prevent said spin nut from rotating about said central axis.

13. The seat assembly of claim 12 said means for engaging said spin nut includes a pair of C-shaped locking arms having first ends pivotally mounted to said flanges by said second pivotal attaching means and second ends extending downwardly from said second pivotal attaching means and through said side wall openings for engagement with said spin nut, said spin nut having a plurality of axially extending locking teeth about the periphery of spin nut and said second ends of said locking arms having complementary locking teeth for engagement with said spin nut locking teeth to prevent rotation of said spin nut.

14. The seat assembly of claim 13 wherein said locking arms are urged by gravity into engagement with said spin nut and further comprising cam portions extending downward from said locking arms for engagement with the outer surface of said end cap, said cam portions being spaced horizontally from said second pivotal attaching means whereby upon upward movement of said end cap to said release position said end cap applies a vertically upward force on said locking arms to rotate said locking arms out of engagement with said spin nut.

15. The seat assembly of claim 12 wherein said means for engaging said spin nut includes a single C-shaped lock lever mounted at its center to said flanges by said second pivotal attaching means, said lock lever having two end portions extending downwardly from said second pivotal attaching means and being balanced about said second pivotal attaching means to leave said end portions spaced from said spin nut during static conditions and said lock lever being rotatable by inertia forces to move one of said end portions into engagement with said spin nut, said end portions including axially extending locking teeth for engagement with said spin nut and said spin nut including complementary locking teeth about its periphery to prevent rotation of said spin nut when engaged by said lock lever.

16. In a seat assembly for a motor vehicle having a base member for attachment of said seat assembly to a motor vehicle, a seat member mounted to said base member for translational movement: relative to said base member and a back member mounted to said seat member for rotational movement relative to said seat member, an actuator for holding two of said relatively movable members in position, said actuator comprising first and second portions mounted to opposite members of said relatively movable members, an annular element defining an axis and being disposed in said second portion and having transverse end faces at opposite axial ends thereof, means axially capturing said element on said second portion, said means axially capturing said element comprising capturing portions which are relatively adjustable to one condition permitting said element to rotate about said axis relative to said first and second portions of said actuator and to another condition preventing such rotation, said element and said first portion of said actuator comprising an operative connection between them which is effective, when said capturing portions are in said one condition and axial forces are concurrently applied to said actuator, to initiate rotation of said element about said axis relative to said first and second portions of said actuator, and said rotation of said element is in turn effective to permit translation of said first portion relative to both said element and said second portion thereby to change the relative positions of said relatively movable members, said capturing portions being disposed in confronting juxtaposition to said end faces of said element and operable in said another condition to apply axial capturing frictional forces against both said end faces great enough to prevent said element from rotating with respect to said first and second portions of said actuator in response to axially applied forces, bearing means and yieldable resilient means disposed in said second portion, said bearing means being urged by said yieldable resilient means to provide bearing support to promote free rotation of said element with respect to said first and second portions when said capturing portions are in said one condition, said yieldable resilient means yield-

ing when said capturing portions are in said another condition so as to allow said capturing portions to apply said axial capturing forces against said end faces to prevent said element from rotating with respect to said first and second portions;

said capturing portions including a housing forming a recess within which said element is disposed and a housing cap covering said recess and being axially slidable relative to said housing, said cap having a first side being disposed in confronting juxtaposition to one end face of said element to apply said capturing frictional forces thereto and a second side opposite said first side and axially spaced therefrom, a cam mounted to said housing having a cam surface engaging said second side of said cap and said cam being movable to apply varying axially forces to said cap second side to move said cap between a first position corresponding to said one condition of said capturing portions and a second position corresponding to said another condition of said capturing portions.

17. The seat assembly of claim 16 further comprising pivotal attaching means for pivotally attaching said second portion to one of said relatively movable members and said pivotal attaching means further attaching said cam to said second portion for rotation of said cam relative to said second portion.

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